

SIMATIC S7

Configuring Hardware and Communication Connections STEP 7 V5.0

Manual

This manual is part of the documentation
package with the order number:
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Important Notes, Contents

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with STEP 7

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Safety Guidelines

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:



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Warning

indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.



Caution

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Note

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We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

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Important Notes

Purpose

This manual provides a complete overview of the procedures involved in configuring hardware and communication connections with the STEP 7 software. It is designed to support you when depicting the hardware configuration in the form of a STEP 7 project and describes how to establish data exchange between automation systems.

The manual is intended for people who are involved in carrying out control tasks using STEP 7 and SIMATIC S7 automation systems.

We recommend that you familiarize yourself with the examples in the manual "Working with STEP 7 V5.0, Getting Started." These examples provide an easy introduction to the topic "Programming with STEP 7."

Basic Knowledge Required

In order to understand this manual, general knowledge of automation technology is required.

In addition, you must be familiar with using computers or PC-similar tools (for example, programming devices) with the Windows 95 / NT or Windows 98 operating system.

Scope of the Manual

This manual is valid for release 5.0 of the STEP 7 programming software package.

STEP 7 Documentation Packages

This manual is part of the documentation package "STEP 7 Basic Information."

The following table displays an overview of the STEP 7 documentation:

Documentation	Purpose	Order Number
STEP 7 Basic Information with <ul style="list-style-type: none"> Working with STEP 7 V5.0, Getting Started Manual Programming with STEP 7 V5.0 Configuring Hardware and Communication Connections, STEP 7 V5.0 From S5 to S7, Converter Manual 	Basic information for technical personnel describing the methods of implementing control tasks with STEP 7 and the S7-300/400 programmable controllers.	6ES7810-4CA04-8BA0
STEP 7 Reference with <ul style="list-style-type: none"> Ladder Logic (LAD)/Function Block Diagram (FBD)/Statement List (STL) for S7-300/400 manuals Standard and System Functions for S7-300/400 	Provides reference information and describes the programming languages LAD, FBD, and STL, and standard and system functions extending the scope of the STEP 7 basic information.	6ES7810-4CA04-8BR0

Online Helps	Purpose	Order Number
Help on STEP 7	Basic information on programming and configuring hardware with STEP 7 in the form of an online help.	Part of the STEP 7 Standard software.
Reference helps on STL/LAD/FBD Reference help on SFBs/SFCs Reference help on Organization Blocks	Context-sensitive reference information.	Part of the STEP 7 Standard software.

Online Help

The manual is complemented by an online help which is integrated in the software. This online help is intended to provide you with detailed support when using the software.

The help system is integrated in the software via a number of interfaces:

- There are several menu commands which you can select in the **Help** menu: The **Contents** command opens the index for the Help on Step 7.
- **Using Help** provides detailed instructions on using the online help.
- The context-sensitive help offers information on the current context, for example, an open dialog box or an active window. You can open the context-sensitive help by clicking the "Help" button or by pressing F1.
- The status bar offers another form of context-sensitive help. It displays a short explanation for each menu command when the mouse pointer is positioned on the menu command.
- A brief explanation is also displayed for each icon in the toolbar when the mouse pointer is positioned on the icon for a short time.

If you prefer to read the information from the online help in printed format, you can print out individual help topics, books, or the entire online help.

This manual is an extract from the HTML-based Help on STEP 7. As the manual and the online help share an almost identical structure, it is easy to switch between the manual and the online help.

Feedback on Documentation

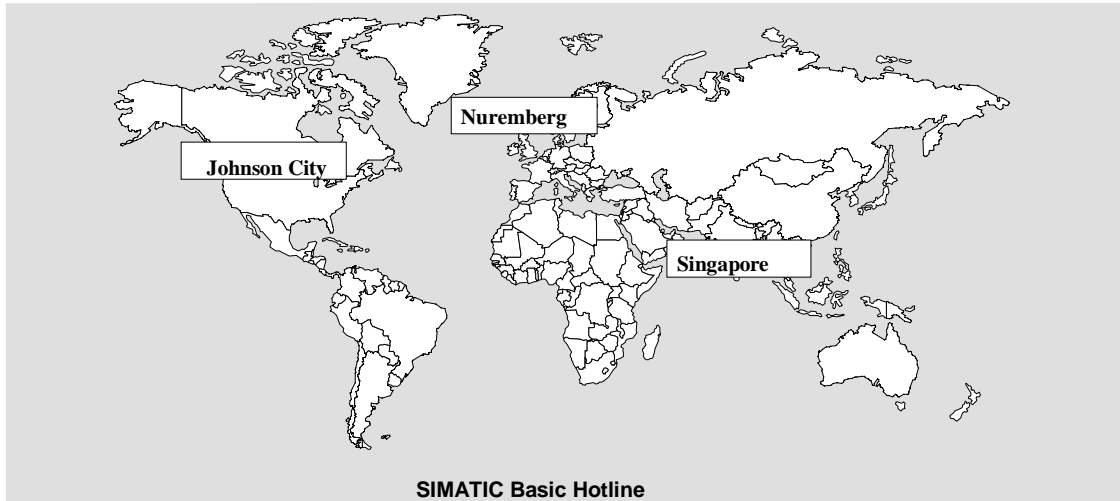
To help us to provide the best possible documentation for you and future STEP 7 users, we need your support. If you have any comments or suggestions relating to this *manual* or the *online help*, please complete the questionnaire at the end of the manual and send it to the address shown. Please include your own personal rating of the documentation.

SIMATIC Training Centers

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 - via the **Bulletin Board System** (BBS) in Nuremberg (*SIMATIC Customer Support Mailbox*) under the number +49 (911) 895-7100.

To dial the mailbox, use a modem with up to V.34 (28.8 Kbps) with the following parameter settings: 8, N, 1, ANSI; or dial via ISDN (x.75, 64 Kbps).

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1 Basics of Configuring Hardware with STEP 7

1.1 Introduction to Configuring Hardware

Configuring

The term "configuring" refers to the arranging of racks, modules, distributed I/O (DP) racks, and interface submodules in a station window. Racks are represented by a configuration table that permits a specific number of modules to be inserted, just like a real rack.

In the configuration table, STEP 7 automatically assigns an address to each module. You can change the addresses of the modules in a station if the CPU in the station can be addressed freely (meaning an address can be assigned freely to every channel of the module, independent of its slot).

You can copy your configuration as often as you like to other STEP 7 projects, modify it as necessary, and download it to one or more existing plants. When the programmable controller starts up, the CPU compares the preset configuration created in STEP 7 with the actual configuration of the plant. Any errors are therefore recognized immediately and reported.

Assigning Parameters

The term "assigning parameters" refers to the following:

- Setting properties for programmable modules in a central structure and in a network. For example: a CPU is a module to which you can assign parameters and its watchdog time is a parameter you can set.
- Setting bus parameters, DP master and DP slave parameters for a master system (PROFIBUS-DP)

The parameters are downloaded to the CPU and transferred by the CPU to the respective modules. Modules can easily be replaced because the parameters set with STEP 7 are automatically downloaded to the new module during startup.

When Should You Configure Your Hardware?

The properties of the S7 programmable controllers and modules are preset with default values such that in many cases you do not need to configure them.

Configuration is necessary in the following cases:

- If you want to change the default parameters of a module (for example, enable a hardware interrupt for a module)
- If you want to configure communication connections
- For stations with a distributed I/O (PROFIBUS-DP)
- For S7-400 stations with a number of CPUs (multicomputing) or expansion racks
- For fault-tolerant (H) programmable control systems (optional package)

1.2 Basic Procedure for Configuring Hardware

1.2.1 Basic Procedure for Configuring Hardware

Window for Configuring

Configuring a programmable controller involves the use of two windows:

- The station window in which you place the racks for the station structure
- The "Hardware Catalog" window from which you select the required hardware components, for example, racks, modules, and interface submodules

Displaying the Hardware Catalog

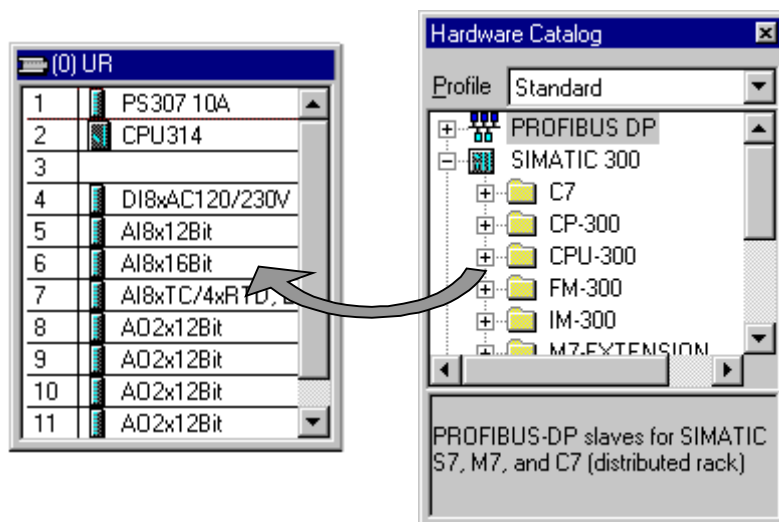
If the "Hardware Catalog" window is not displayed, select the menu command **View > Catalog**. This command toggles the display of the Hardware Catalog on and off.

1.2.2 Basic Steps for Configuring a Station

Independent of which structure a station has – you always configure using the following steps:

1. Select a hardware component in the "Hardware Catalog" window.
2. Copy the selected component to the station window using drag & drop.

The following figure shows the basic operation:



1.2.3 Layout of the Station Window

The lower part of the station window shows a detailed view of the inserted/selected rack. The order numbers and addresses of the modules are shown here in table form.

The table has the structure shown below for a central rack equipped with modules (detailed view):

Slot	Module	Order Number	M...	I...	Q...	Comment
1						
2	CPU314	6ES7 314-1AE0				
3						
4	DI8xAC120/230V	6ES7 321-1FF8		0		
5	AI8x12Bit	6ES7 331-7KF0		272...		
6	AI8x16Bit	6ES7 331-7NF0		288...		
7	AI8xTC/4xRDT, Ex	6ES7 331-7SF0		304...		
8	AO2x12Bit	6ES7 332-5HB0			320...	
9	AO2x12Bit	6ES7 332-5HB8			336...	

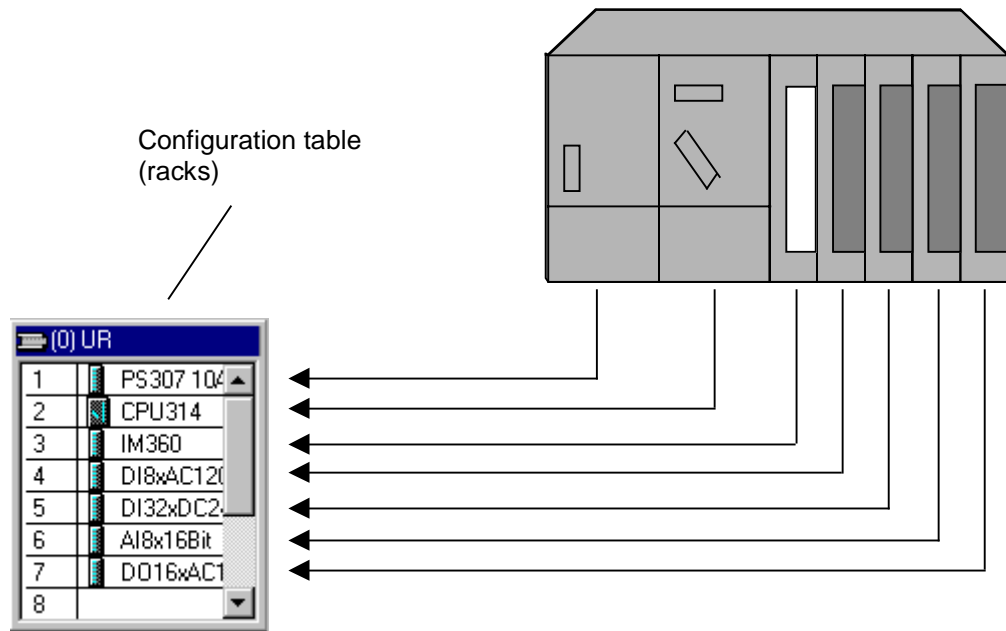
1.2.4 Configuration Table as an Image of a Rack

For a central structure you arrange the modules beside the CPU in a rack and continue into additional expansion racks. The number of racks which can be configured depends on the CPU you used.

Just as you do in a real plant, you arrange your modules in racks with STEP 7. The difference is that in STEP 7 racks are represented by "configuration tables" that have as many rows as the rack has slots for modules.

The following figure shows an example of how a real structure is converted into a configuration table. The configuration table corresponds to the rack used; STEP 7 automatically places the number of the rack in brackets in front of the name.

Example: (0) UR corresponds to the central rack (Universal Rack) number 0.



1.2.5 Setting the Properties of Components

Once you have arranged your components in the station window, you always arrive in the following manner in a dialog box for changing the default properties (parameters or addresses):

- Double-click the component or select the menu command **Edit > Object Properties**.
- Right mouse button: Move the cursor on the component, press the right mouse button and select the command **Object Properties** from the pop-up menu.

Properties of CPUs

The properties of the CPUs have a special significance for the behavior of the system. In the dialog boxes for a CPU, you can set the following, for example: startup characteristics, local data areas and priorities for interrupts, memory areas, retentive behavior, clock memory, protection level, and password – to name only a few. STEP 7 "knows" what can be set and within what range limits.

In the "General" tab of the CPU or via the properties of the CPU interface you can assign parameters to the interfaces (for example, MPI or integrated PROFIBUS-DP interfaces). Via these dialog boxes you can also access the properties dialog box for the corresponding subnet to which the CPU is to be connected.

Other Ways of Assigning Parameters

For S7-300 and S7-400 programmable controllers you can set the parameters for some modules in the user program (for example, for analog modules). You need to call the system functions (SFCs) WR_PARM, WR_DPARM, and PARM_MOD in the user program to do this. These settings are lost following a warm restart.

You will find more detailed information about system functions in the *System Software for S7-300 and S7-400, System and Standard Functions Reference Manual*

For M7-300 and M7-400 programmable control systems you can set the parameters for signal modules in the C program. You need to call the M7 API function "M7StoreRecord" in the C program to do this. This function transfers the parameters to a signal module.

You will find more information about the M7 API functions in the manuals on the system software for M7-300 and M7-400.

1.2.6 What You Should Know About Slot Rules and Other Rules

STEP 7 offers you support with configuring a station so that a message is generally displayed immediately if, for example, a module cannot be inserted in the slot you want to insert it in.

Furthermore, because address ranges are checked automatically, double address assignments cannot occur.

In this connection, please pay attention to the status bar at the lower edge of the window and to any displayed messages that provide details on the causes and effects of an operation. You can also use the online help to obtain additional information for the messages.

Other additional, temporary rules (for a specific release), such as restrictions to the slots you can use owing to a functional restriction to individual modules, are not taken into account. Consequently, always consult the documentation or the current Product Information for the modules.

1.3 Overview: Procedure for Configuring and Assigning Parameters to a Central Structure

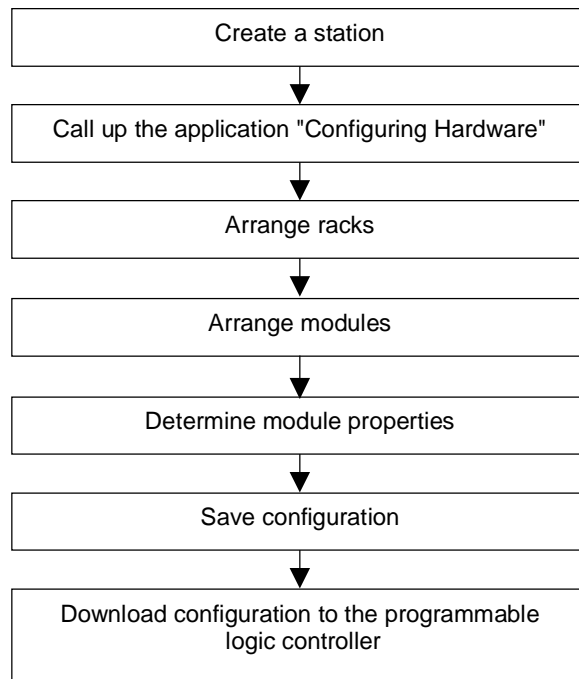
1.3.1 Overview: Procedure for Configuring and Assigning Parameters to a Central Structure

Requirement

You must have opened a project or created a new project in the SIMATIC Manager.

Basic Procedure

To configure and assign parameters to a structure, proceed as shown below:



Summary

As usual in Windows applications, you can put together the whole configuration in STEP 7 using drag and drop. You will find detailed information on handling and setting up your real plant configuration, for example, how you configure the connection to expansion racks or how you configure special components in the STEP 7 online help.

1.4 Customizing the Hardware Catalog

1.4.1 Customizing the Hardware Catalog

In addition to the standard Hardware Catalog supplied with STEP 7, you can tailor your "own" catalog. This can result in a number of different catalog profiles. The basis for each new catalog profile is the standard Hardware Catalog with all modules/components – the profile for this catalog is called "Standard"; you can assign your own names for the catalog profiles you create yourself.

Example: You can create a catalog profile that contains only the modules you are currently using.

Procedure

1. Select the menu command **Options > Edit Catalog Profiles**.
In the application that opens, two catalog profiles are displayed: the "Standard" profile and an "empty" profile that does not contain any components as yet.
2. Drag the required folders and modules from the standard profile window and drop them in the empty profile window. You can also adapt the structure to your own requirements using the menu command **Insert > Folder**.
3. Save the new catalog profile using the menu command **File > Save As**; choose a suitable name for the new profile.
The name of the new profile then appears in the "Profile" list box in the Hardware Catalog and can be selected.

1.5 Tips for Editing Station Configurations

1.5.1 Tips for Editing Station Configurations

Docking the "Hardware Catalog" Window on the Side of the Station Window

To prevent the "Hardware Catalog" window obscuring the contents of the station window, you can "dock" it on one side edge of the station window; meaning it is then positioned and fixed there. Simply double-click the area above the "Profile" list box in the Hardware Catalog. To release the "docked" window, double-click in this area once again.

You can change the size of the "Hardware Catalog" window when the window is undocked.

Moving Modules

You can move modules or other components in a simple manner by dragging & dropping them into another valid slot within the station.

Exchanging Modules

If you have already created a configuration and wish to exchange a module for which parameters have been specified previously (for example, CPU or analog module) with another module without "losing" the assigned parameters or connection configuration, then proceed as follows:

1. Drag the new module (for example, CPU) to the slot containing the module you want to replace.
2. Confirm you want to replace the module in the dialog box which appears.

If the message "The slot is already occupied" appears, you must activate the function first using the menu command **Options > Customize** and selecting the option "Enable module exchange."

Module exchange is only possible for "compatible" modules. If the modules are not compatible, you must delete the "old" module, insert the new module, and assign new parameters. If you attempt to exchange modules which are not compatible, STEP 7 issues a corresponding message.

Example: You cannot exchange a CPU with parameters assigned for a CPU with a new order number - the entire parameter assignment (for example, the MPI address) will be adopted by the new module.

Selecting a Number of Rows in the Configuration Table

If you want to select a number of rows in the configuration table, for example, to copy or delete a number of modules or insert a number of modules of the same type, proceed as follows:

To select all rows:	Select the menu command Edit > Select > All .
To select a group of consecutive rows:	Click on the first row of the group you want to select. Keep the SHIFT key pressed and click on the last row of the group you want to select.
To select a number of rows:	Press CTRL, keep it pressed, and click on each row you want to select.

Handling Complex Stations

If you have a complex station structure with a lot of racks, for example, you can set the configuration tables to their minimum size.

1. Select the configuration table.
2. Press the right mouse button and select the menu command **Minimize** in the pop-up menu.

You can also set this overview using the menu command **Options > Customize**.

Arranging the Racks in the View Automatically

Using the menu command **View > Arrange Racks** you can let STEP 7 arrange your current view automatically.

2 Configuring Central Racks

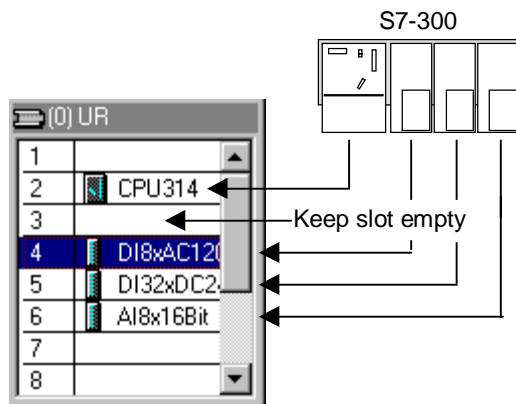
2.1 Rules for Arranging Modules (SIMATIC 300)

2.1.1 Rules for Arranging Modules (SIMATIC 300)

Basic Rule

Modules must be inserted in the rack without gaps.

Exception: For installations with one rack, one slot in the configuration table must remain free (reserved for the interface module). With the S7-300, this is slot 3 and with M7-300, the slot after the module group (slot 3, 4, 5, or 6). In the actual configuration there is no gap because the backplane bus would be interrupted.



Slot Rules (S7-300)

Rack 0:

- Slot 1: Power supply only (for example, 6ES7 307-...) or empty
- Slot 2: CPU only (for example, 6ES7 314-...)
- Slot 3: Interface module (for example, 6ES7 360-.../361-...) or empty
- Slots 4 through 11: Signal or function modules, communications processors, or free.

Racks 1 to 3:

- Slot 1: Power supply module only (for example, 6ES7 307-...) or empty
- Slot 2: Free
- Slot 3: Interface module
- Slots 4 through 11: Signal or function modules, communications processors (dependent on the inserted interface module), or free.

Special Rules for the Dummy Module (DM 370 Dummy)

Special Rules for the Digital Simulation Module (SIM 374 IN/OUT 16)

Special Rules for M7-300

2.1.2 Special Rules for the Dummy Module (DM 370 Dummy)

A dummy module (DM 370 Dummy) is a module that you can insert instead of a module that will be used later.

Depending on the switch setting, the module may or may not reserve address space for a module. For example, address space is reserved for a digital input/output module but not for an interface module.

Switch Setting on DM 370 Dummy	Meaning	Order Number
A	Address space can be reserved. Modules in a modular DP slave ET 200M: reserve 0 bytes of address space.	6ES7370-0AA00-0AA0
NA	No address space reserved.	None (Module is "not visible"; it is not configured)

2.1.3 Special Rules for the Digital Simulation Module (SIM 374 IN/OUT 16)

The SIM 374 IN/OUT 16 digital simulation module can be used to simulate digital inputs and outputs.

You **cannot** find this module in the "Hardware Catalog" window. You must place the module you want to simulate in the configuration table instead of the SIM 374.

Switch Setting on SIM 374 IN/OUT 16	Module to Place
16xOutput	6ES7322-1BH00-0AA0
8xOutput 8xInput	6ES7323-1BH00-0AA0
16xInput	6ES7321-1BH00-0AA0

2.1.4 Special Rules for M7-300

When you configure an M7-300 module group, each module in the group occupies a slot.

If the first module of the module group is an M7-300 CPU, then the next slot after the module group can be occupied only by either an interface module or it remains empty.

Module Group (M7-300)

An M7-300 module group is formed when expansion modules (EXM) or a mass-storage module (MSM) are used to extend an M7 CPU or an M7 FM (function module). All modules in the module group are connected with each other via their AT-ISA bus and form, in effect, the automation computer.

First arrange the basic module (M7 CPU or M7 FM) and then the expansion modules in the configuration table. Otherwise you will not be able to insert the expansion modules.

Arranging Modules in a Module Group (M7-300)

A module group results in new slot rules:

- The M7 CPU or the expandable M7 FM is always the **first** module in the module group.
- The mass-storage module (only one can be inserted) is always the **last** module within the module group.
- The M7 CPU or M7 FM may not be expanded by more than three modules (MSM or EXM). The permitted number of expansion modules is documented for the appropriate M7 FMs.

2.2 Rules for Arranging Modules (SIMATIC 400)

2.2.1 Rules for Arranging Modules (SIMATIC-400)

The rules for the arrangement of modules on a rack of the S7-400 depend on the type of the installed rack.

Central Rack

The following rules apply:

- Insert power supply modules only in slot 1 (exception: power supply modules with redundant capability)
- Insert a maximum of six interface modules (send IMs), not more than two with power transmission
- Connect a maximum of 21 expansion racks using interface modules to the central rack
- Connect not more than one expansion rack **with power transmission** to an interface of the send IM (IM 460-1 coupled with IM 461-1);
- Connect a maximum of four expansion racks **without power transmission** (IM 460-0 with IM 461-0 or IM 460-3 with IM 461-3).

Expansion Rack

The following rules apply:

- Insert power supply modules only in slot 1
- Insert the interface module (receive IM) only in the extreme right slot (slot 9 or slot 18).
- Communication bus modules should only be inserted in expansion racks with a number not greater than 6 (otherwise, they cannot be addressed).

2.2.2 Special Rules for Power Supply Modules with Redundant Capability (S7-400)

Power supply modules with redundant (standby) capability can be inserted in a rack twice. These modules can be recognized by their info text in the "Hardware Catalog" window.

You should observe the following rules:

- It is only possible to insert power supply modules with redundant capability in the racks intended for this purpose (these can be recognized by the higher order number and info text in the "Hardware Catalog" window).
- The power supply modules with redundant capability must be inserted in slot 1 and the slot immediately next to it (no gaps allowed).
- Power supply modules with and without redundant capability cannot be inserted in the same rack (no "mixed" configurations possible).

2.2.3 Special Rules for M7-400

An M7-400 module group is formed when expansion modules (EXM, ATM) or a mass-storage module (MSM) are used to extend an M7 CPU or an M7 FM.

First arrange the basic module (M7 CPU or M7 FM) and then the expansion modules in the configuration table. Otherwise you will not be able to insert the expansion modules.

Arranging Modules in a Module Group (M7-400)

The following rules apply:

- Not more than one mass-storage module (MSM) can be inserted.
- The M7 CPU may not be expanded by more than three modules (EXM, ATM, or MSM).
- The modules of the module group can be arranged only in the following order to the right of the M7 CPU:
 - EXM module(s)
 - MSM module
 - ATM module(s).

2.2.4 Special Rules for PROFIBUS-DP Interface Submodules (M7-400)

If you wish to use an interface submodule for PROFIBUS-DP in an M7-400 programmable controller (for example, IF 964-DP as DP master), then you should note the following:

- No other interface submodule can be inserted in the CPU, FM, or EXM under this interface submodule.
- An interface of the CPU, FM, or EXM that is below this interface submodule cannot be used.

Reason: The PROFIBUS bus connector covers the module slot or interface below.

Recommendation: Insert an interface submodule for PROFIBUS-DP only in the lowest or in the lower left module slot of a CPU, FM, or EXM.

2.3 How to Configure Central Racks

2.3.1 Creating a Station

Requirement

You must have opened the SIMATIC Manager and opened a project or created a new project.

Procedure

A station can only be created directly beneath a project.

1. Select the project in the left half of the project window.
2. Select the menu command **Insert > Station > SIMATIC 300-Station** or **... > SIMATIC 400-Station**.
3. The station is created with a preset name. You can replace the name of the station with a more relevant name of your own.

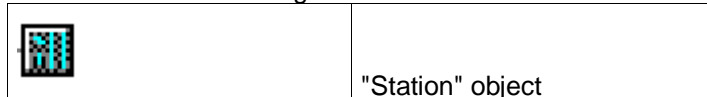
2.3.2 Starting the Application to Configure the Hardware

Requirement

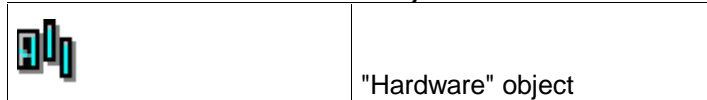
You must have created a station (SIMATIC 300, SIMATIC 400).

Procedure

1. Select the "Station" object in the project window so that the "Hardware" object becomes visible in the right half of the station window.



2. Double-click on the "Hardware" object.



Alternatively you can select the "Station" object and then the menu command **Edit > Open Object**.

Result: A station window and the module catalog (if it was still open when you last exited the application) appear on the screen. You can position racks and other components in accordance with the station structure; select the components required for the station structure from the module catalog ("Hardware Catalog" window).

Opening More Stations in HW Config

Using the menu command **Station > New** you can configure another station in the same project; using **Station > Open** you can open an existing (offline) station configuration for editing.

2.3.3 Arranging the Central Rack

Requirement

The station window must be open and you must have a plan of the hardware configuration of the station.

Procedure

1. Select a suitable central rack ("Rack") for your configuration from the "Hardware Catalog" window; in SIMATIC 300 the Rail, in SIMATIC 400 the Universal rack (UR1), for example.
2. Drag the rack to the station window.
The rack appears in the form of a small configuration table in the upper part of the station window. In the lower part of the window, the detailed view of the rack appears with additional information such as the order number, MPI address, and I/O addresses.
Alternatively to steps 1 and 2, you can also double-click the rack in the "Hardware Catalog" window.

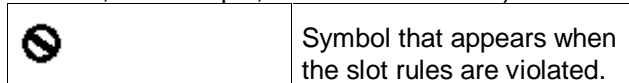
2.3.4 Arranging Modules in a Rack

Requirement

You have arranged a rack in a station window and the rack is not shown minimized (the rack slots are visible).

Procedure

1. Select a module (for example, a CPU) from the "Hardware Catalog" window.
2. Drag & drop the module into the appropriate row of the rack (configuration table). STEP 7 checks whether any slot rules are violated (an S7-300 CPU must not, for example, be inserted in slot 2).



3. Repeat steps 1 and 2 until the rack has been fully equipped with the required modules.

Alternatively, you can also select the appropriate row or rows in the configuration table and double-click on the required module in the "Hardware Catalog" window. If several rows have been selected, then all selected rows are assigned with the module at once.

Representing Interfaces and Interface Submodules

The interfaces and interface submodules are shown in the configuration table in a separate row. The row has the same name as the interface (for example, X1) or - if the module has slots for interface submodules – bears the prefix "IF" (for example, IF1).

With **integrated interfaces** the name of the interface appears in the "Module" column; with modules with slots for **interface submodules** you can copy a suitable interface submodule (IF) from the "Hardware Catalog" window to the appropriate row using drag & drop.

2.3.5 Arranging C7 Control Systems (Special Features)

In a C7 control system (C7-620), the following components are integrated in one casing:

- SIMATIC 300 CPU
- Inputs and outputs (digital and analog)
- Interface module IM 360 for connecting further SIMATIC 300 modules
- Line-oriented operator panel with a printer port

Simplified Procedure

The C7 control system is not mounted on a rail – this means you do not have to arrange a rack.

Requirement

The station window and "Hardware Catalog" window must be visible.

Procedure

1. Select a C7 control system from the "Hardware Catalog" window. These systems can be found under SIMATIC 300.
2. Drag the C7 control system to the station window.
3. If you want to expand the C7 control system:
 - Select rails as racks from the "Hardware Catalog" window.
 - Drag the racks to the station window one by one.
 - Assign modules to the racks. Important: The interface modules (IM) must be inserted in all racks so that connecting up is possible.

2.3.6 Arranging SIMATIC PC-Based Control (Special Features)

"SIMATIC PC-Based Control" is the PC-based solution for visualization, communication, data processing and control from a single PC platform.

SIMATIC PC-Based Control contains the following and other essential components for configuration with STEP 7:

- WinAC CPU 4xx (SlotPLC)
- WinLC Vx.y (Software SPS)

Requirement

The station window and "Hardware Catalog" window are visible.

2.3.7 Procedure for WinAC CPU 4xx Versions

1. Create a **SIMATIC 400** type station.
2. Select the "Module" WinAC CPU 4xx in the "Hardware Catalog" window and drag and drop it to the empty station window.
3. Complete the configuration if necessary using the components arranged in the Hardware Catalog window under the "Module" WinAC CPU 4xx (for example, CP for connection to Industrial Ethernet).

2.3.8 Procedure for WinLC Vx.y Versions

1. Create a **SIMATIC 300** type station.
2. Select from the "Hardware Catalog" window the "Module" which matches the WinLC version you have installed (WinLC Vx.y) and drag and drop it to the empty station window.

2.3.9 Assigning Properties to Modules/Interfaces

Introduction

Properties of components such as modules or interfaces are addresses and parameters. Only if you want to change the default values do you need to read the following sections.

Requirement

You have arranged in the configuration table the component for which you want to modify the properties.

Procedure

Every component (module, interface, or interface submodule) has default properties; for example, default measurement types and measuring ranges for analog input modules.

If you want to change these settings, proceed as follows:

1. Double-click in the configuration table on the component (for example, module or interface submodule) that is to have parameters assigned or select the row and select the **Edit > Object Properties** menu command.
Using the right-hand mouse button: Move the mouse pointer to the component, press the right-hand mouse button, and select the **Object Properties** command from the pop-up menu
2. Use the displayed tabbed dialog boxes to assign the component properties.

2.3.10 Assigning Addresses

There is a difference between assigning addresses to nodes and assigning input/output addresses (I/O addresses).

Node addresses are addresses of programmable modules (MPI, PROFIBUS, Industrial Ethernet addresses); they are required in order to be able to address the various nodes in a subnet, for example, in order to download a user program to a CPU. You will find information on assigning node addresses in the subnet in the chapter on networking stations.

Input/output (I/O) addresses are required in order to read inputs and set outputs in the user program.

Special Feature: MPI Addresses of FMs and CPs (S7-300)

Communications processors (CPs) and function modules (FMs) with their own MPI address have a special feature: their MPI address is determined automatically by the CPU and assigned according to the following pattern:

- First CP/FM after the CPU: MPI address of the CPU + 1
- Second CP/FM after the CPU: MPI address of the CPU + 2

The newer S7-300 CPUs (see CPU manual or Product Information) permit free MPI address allocation for such CPs and FMs (via the "General" tab for the module).

2.3.11 Assigning I/O Addresses

STEP 7 assigns input and output addresses when modules are placed in the configuration table. This means every module has a start address (address of the first channel); the addresses for the remaining channels are based on this start address.

Requirements

- The module is inserted in a central rack or expansion rack and the CPU must permit free address assignment.
- The module is inserted in a DP slave or the module is a DP slave (compact DP slave).

Procedure

1. Double-click on the row of the rack containing the module whose start address you wish to set, or select the module and select the **Edit > Object Properties** menu command.
2. Select the "Addresses" tab.
3. Change the default start address.

Note

For modules within a local bus segment, formed by a function module (S7-300) or for special function modules (S7-400), you have to assign a further start address. In addition to the start address for the CPU, the module then has a start address for the FM. In the overall view of the configuration table, the start address from the point of view of the FM is always displayed in this case.

Displaying the Address Overview

You can display the input and output addresses already used and any address gaps as follows:

1. Open the station whose addresses you want to display.
2. Select the menu command **View > Address Overview**.
3. In the "Address Overview" dialog box, select the module whose assigned inputs and outputs you want to display (for example, CPU).
4. If required, you can filter the display by address type (for example, input addresses only).

The address areas "Inputs" and "Outputs" are displayed with locations for the modules (DP master system, PROFIBUS address, rack, slot, interface submodule slot). Input addresses with the length 0 (for example, addresses of interface modules) are marked with an asterisk (*).

2.3.12 Assigning Symbols to I/O Addresses

Introduction

You can assign symbols to input/output addresses when you configure modules without having to go via the symbol table.

You can only assign symbols to the inputs and outputs of digital or analog modules when configuring the hardware. With integrated inputs/outputs (for example, CPU 312 IFM), in CPs, FMs, and S5 modules (for example, configured via the adapter module) you must assign the symbols in the symbol table.

The assigned symbols are not downloaded to the station (menu command: **PLC > Download**). The consequence of this is: when you upload a station configuration back into the programming device (menu command: **PLC > Upload**), no symbols are displayed.

Procedure

1. Select the digital/analog module to whose addresses you want to assign symbols.
2. Select the menu command **Edit > Symbols** or press the right mouse button and select the **Symbols** command in the pop-up menu.
You can assign symbols in the dialog box that appears.
If you click the "Add Symbol" button in the dialog box, the name of the address is entered as the symbol.

2.3.13 Configuring S5 Modules

You can insert S5 modules in a SIMATIC 400 station. These modules are connected via:

- An S5 adapter module (IM 470) or
- An IM 463-2 for connecting S5 expansion devices with IM 314

You can find these modules in the "Hardware Catalog" window under "IM 400."

Note

You must configure the input or output address areas of the S5 modules for each connection. (Double-click the adapter module or IM 463-2 and then select the "Input Addresses" or "Output Addresses" tab.)

If the address areas are not configured, the modules mentioned above will not be saved in the system data blocks (SDB). Result: The configuration which was downloaded to the CPU will not contain information about these modules. If this configuration is uploaded to the programming device, these modules will not appear in the configuration table.

2.4 Expanding the Central Rack with Expansion Racks

2.4.1 Expanding the Central Rack with Expansion Racks

Configuring Expansion Racks in SIMATIC 300

For SIMATIC 300 stations, only "Rails" are available as central racks and as expansion racks; this means you can position as many rails (max. 4) as there are in the actual configuration.

Expansion racks are linked in STEP 7 by inserting the appropriate interface module in slot 3 of every rack.

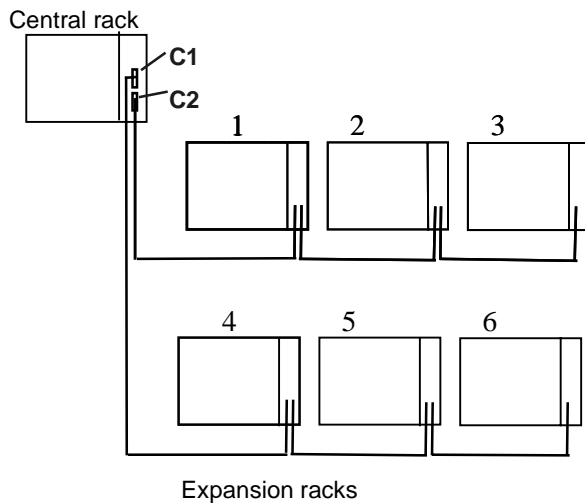
- To expand the configuration by one rack:
racks 0 and 1: IM 365
- To expand the configuration by up to three racks:
rack 0: IM 360; racks 1 to 3: IM 361

Configuring Expansion Racks in SIMATIC 400

In SIMATIC 400, the possibilities for expansion are more complex owing to the different racks and interface modules.

All expansion racks that are connected to an interface of the send IM on the central rack form a **cascade**.

In the following figure, three expansion racks are connected to each interface of the send IM.



2.4.2 Rules for Connecting Expansion Racks (SIMATIC 400)

If you connect expansion racks (SIMATIC 400) to an interface module (send IM) of the central rack, then the following characteristics for the send IM and the receive IM must match:

- Power transfer (with/without)
- Type of link (centralized/distributed)
- Communication bus transmission (with/without interrupt transmission).

2.4.3 Arranging the Expansion Rack (SIMATIC 400)

Procedure

1. Select the appropriate (expansion) racks from the "Hardware Catalog" window.
2. Drag the racks to the station window one by one.
3. If you wish to change the number of the rack:
Double-click the second row of the rack in the upper half of the station window.
You can change the number in the "General" tab for the rack.
4. Assign modules to the racks.
Important: To permit the racks to be connected to each other, the interface modules must be inserted in all racks.
5. **For S7-400 only:** make the connections between the interface modules in the racks:
 - Double-click on the send IM.
 - Select the "Connect" tab
This tab shows all racks that are not connected (racks with inserted receive IMs).
 - Select the individual racks and use the "Connect" button to connect them to the required interface of the send IM (C1 or C2).
Connection lines then show how the racks are connected together.

2.4.4 Special Case: When the Central Rack Has More Than One CPU

If you wish to extend the configuration which consists of the segmented rack CR2 (S7-400) or a multicomputing configuration with racks you must adhere to the following order:

1. Configure the central rack (for example, CR2) with the send IM.
2. **Only** insert receive IMs in the expansion racks.
3. Remove the connections between the interface modules (IMs) as described above.

Only then can you insert modules in the expansion racks. Reason: Because the address space exists more than once for multiple CPUs, the expansion rack must first be assigned to an address space (= a CPU).

3 Configuring the Distributed I/O (DP)

3.1 Configuring the Distributed I/O (DP)

Introduction

The distributed I/O refers to master systems, comprising DP (distributed I/O) master and DP slaves which are connected via a bus cable and communicate with each other via the PROFIBUS-DP protocol.

As DP masters and DP slaves can be different devices, this section only explains the basic procedures involved in configuring. You will find details on functionality, access procedures etc. in the manuals for the specific devices and in the online help for the special FCs (for example, DP-SEND and DP-RECEIVE for CP 342-5).

3.2 Basic Procedure for Configuring a DP Master System

If you know the principles of how to configure a central structure, you also know how to configure the distributed I/O – the procedure is the same to a large extent.

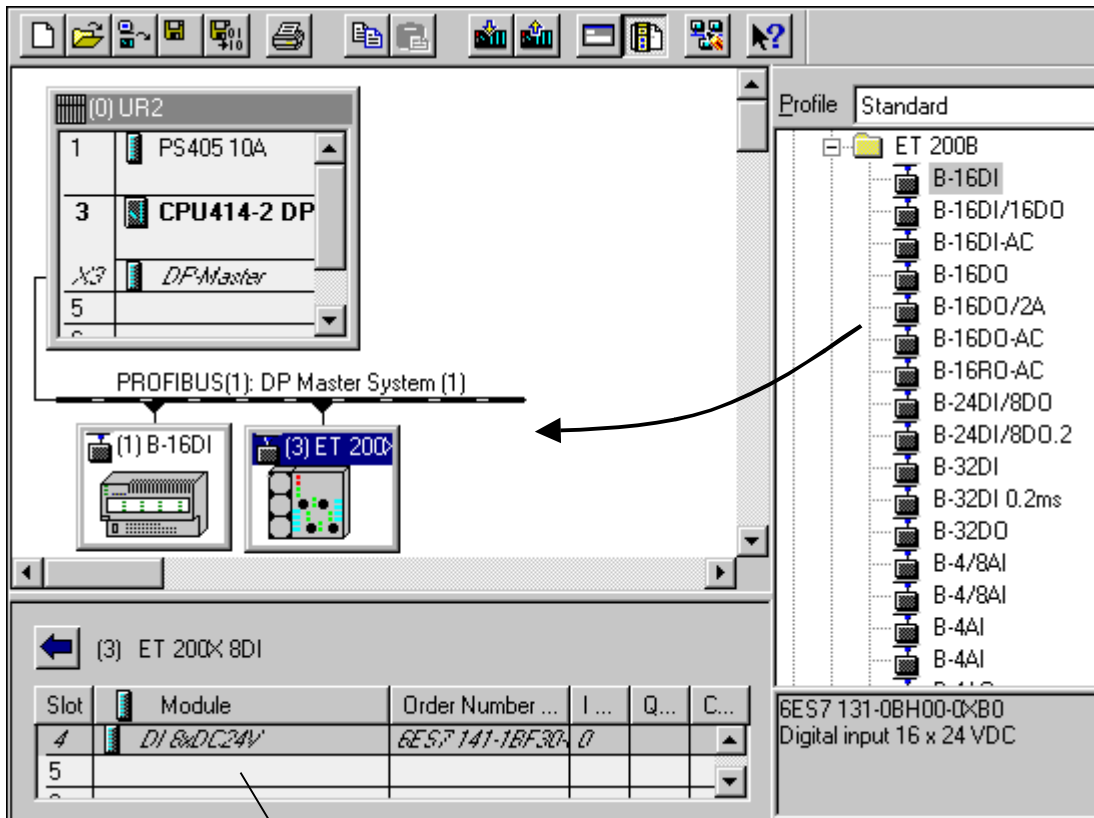
Station Window as an Image of the Real DP Master System

When you place a DP master (for example, a CPU 315-2DP), STEP 7 automatically draws a line that represents the master system. At the end of the line, place the DP slaves that are assigned to this DP master using drag & drop from the "Hardware Catalog" window under "PROFIBUS-DP."

As a DP master system is always connected to a PROFIBUS subnet, STEP 7 automatically displays dialog boxes for setting the subnet properties (for example, transmission rate) and the PROFIBUS address when you place the DP components.

DP Slave Does Not Appear in the "Hardware Catalog" Window

If a DP slave does not appear in the "Hardware Catalog" window, you must install the corresponding *.GSE file after the start of STEP 7 using the menu command **Options > Install New *.GSE Files**. The dialog boxes then guide you through the process of installing the *.GSE file. The installed DP slave then appears in the "Hardware Catalog" window under "PROFIBUS DP - Other Field Devices."






Detailed view for selected DP slave

Slave Configuration in the Detailed View

If you select the DP slave, the slave structure (DP identifiers and modules/submodules) and I/O addresses are displayed in the detailed view of the station window.

Switching Between the DP Master System and the DP Slave in the Detailed View of the Station Window

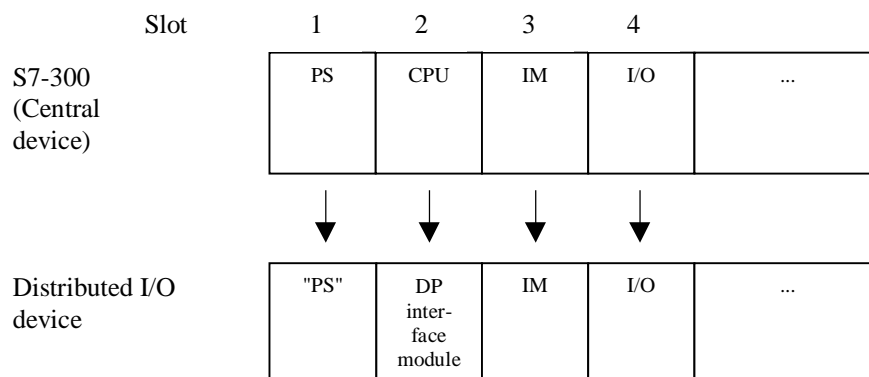
If you select the symbol for the DP master system (—) , all DP slaves belonging to the DP master system will be displayed in the lower half of the station window. If you select a DP slave symbol, the configuration of the DP slave is displayed in the lower half of the station window. You can easily change between displays by using the  and  buttons.

Slot Numbering in Distributed I/O Devices

Depending on which DP slave type you are configuring, the slots in the detailed view of the DP slave begin either with "0" or "4."

With DP slaves that are configured by *.GSE files, the *.GSE file specifies at which slot the I/O addresses start; the slots before that are "empty."

Slot numbering of DP slaves such as ET 200M that are completely integrated in STEP 7 is derived from the structure of an S7-300 station according to the following pattern:



Remarks on the slots of a DP slave:

- The "actual" I/O (inputs/outputs) always starts with slot 4.
- Independent of whether a power supply module (PS) is inserted in the real configuration or not: slot 1 is always reserved for a PS.
- Slot 2 is always reserved for the DP interface module.
- Slot 3 is always reserved for an expansion interface module (IM), independent of whether a "real" I/O device can be expanded or not.

This pattern is used for all DP slave types; modular and compact. The slot arrangement is important for evaluating diagnostic messages (the slot that triggers diagnostics).

3.3 Where Are the DP Slaves in the Hardware Catalog Window?

All DP slaves can be found in the "Hardware Catalog" window under the "PROFIBUS-DP" folder.

The following applies here:

The DP master is...

- ...a SIMATIC 300 or SIMATIC 400 **CPU with integrated PROFIBUS-DP interface:**
The DP slaves appear under their "family name" (for example, ET 200B).
- ...a **CP** with PROFIBUS-DP interface:
The DP slaves appear either in the "CP 342-5 as DP Master" folder and then under their "family name" ("older" CPs) or directly under their "family name" ("newer" CPs).

The DP slave was purchased separately (with a new *.GSE file)

The DP slave will appear in the "Other Field Devices" folder after you have installed the *.GSE file.

The DP slave is an intelligent DP slave

Examples: You can configure stations as a DP slave with:

- CP 342-5 DP
- CPU 315-2 DP, CPU 316-2 DP, CPU 318-2 DP
- Basic submodule ET 200X (BM 147/CPU)

The DP slave appears under the "Configured Stations" folder after configuring the station. The procedure (how does a station appear in the "Configured Stations" folder?) is described in detail in the section about the intelligent DP slaves.

3.4 How to Configure the Distributed I/O

3.4.1 Creating a DP-Master System

Requirement

You have arranged a rack in a station window and the rack is shown as being open (the rack slots are visible).

DP Master

You can use the following items as DP master:

- A CPU with a fixed integrated or installable DP master interface (fixed integrated, for example, CPU 315-2 DP).
- An interface submodule that is assigned to a CPU/FM (for example, IF 964-DP in CPU 488-4).
A CP in conjunction with a CPU (for example, CP 3425, CP 4435).

Procedure

1. Select a DP master from the "Hardware Catalog" window (for example, CPU 315-2 DP).
2. Drag the module to a suitable row in the rack. The "Properties – PROFIBUS Node" dialog box opens.
Here you can do the following:
 - Create a new PROFIBUS subnet or select an existing subnet
 - Set properties for the PROFIBUS subnet (transmission rate etc.)
 - Set the PROFIBUS address of the DP master

3. Confirm the settings with "OK."

The following symbol appears: 

This symbol is the "anchor" for the DP slave of the master system.

Tip: If you cannot find the symbol immediately, it may be hidden by the configuration table. Make the width of the configuration table containing the DP master smaller. If the symbol for the DP master system is still not visible, select the menu command **Insert > DP Master System**.

3.4.2 Selecting and Arranging DP Slaves

Types of DP Slaves

When configuring DP slaves, we differentiate between:

- Compact DP slaves
(modules with integrated digital/analog inputs and outputs, for example, ET 200B)
- Modular DP slaves
(interface modules with S5 or S7 modules assigned, for example, ET 200M)
- Intelligent slaves (I slaves)
(S7-300 stations with, for example, CP 342-5, CPU 315-2DP, or ET 200X with BM 147/CPU)

Note

Note the technical specifications (max. number of nodes, max. number of slots, max. number of user data) of the DP master when configuring the master system. It is possible that you may not be able to configure the maximum number of nodes owing to the limits for the number of slots or user data.

Requirement

A DP master system must be present and visible in the station window.

Symbol for the DP master system: 


If the symbol is not visible (for example, it was deleted), you can create it by selecting the row for the DP interface of the DP master and selecting the menu command **Insert > DP Master System**.

3.4.3 Copying Multiple DP Slaves

1. Hold CTRL pressed and click on the DP slaves you want to copy one by one.
Result: The DP slaves are selected.
2. Select the menu command **Edit > Copy**.
3. Select the DP master system to which the copied DP slaves are to be added.
4. Select the menu command **Edit > Paste** ("normal" copying) or **Edit > Redundant Paste** (when copying for software redundancy).

3.4.4 Configuring Compact DP Slaves


Procedure

1. Select a compact DP slave (for example, ET 200B) from the "Hardware Catalog" window.
 2. Drag the DP slave to the following symbol for a DP master system:

 The "Properties – PROFIBUS Node" dialog box opens. Here you can set the following:
 - The properties for the PROFIBUS subnet (transmission rate etc.)
 - The PROFIBUS address of the DP slave.
 3. Confirm the settings with "OK."
- Result:** A symbol is attached to the DP master system to represent the compact DP slave. The I/O configuration of the compact DP slave is displayed in the lower half of the station window (detailed view).

Assigning I/O Addresses

3.4.5 Configuring Modular DP Slaves

Procedure

1. Select an interface module for a modular DP slave (for example, IM 153 for ET 200M) from the "Hardware Catalog" window.
 2. Drag the interface module to the following symbol for the DP master system:

Result: The "Properties – PROFIBUS Node" dialog box opens. Here you can set the following:
 - The properties of the PROFIBUS subnet (transmission rate, etc.).
 - The PROFIBUS address of the DP slave.
 3. Confirm your settings with "OK."
- A symbol for the DP slave is attached to the DP master system. The detailed view of the DP slave appears in the lower half of the station window showing all the possible slots or DP identifiers.

4. Assign the modules for the modular DP slave in the lower half of the station window.
For modular DP slaves, the possible modules are arranged in the "Hardware Catalog" window below the associated DP slave "family."
These are:
 - Terminal blocks (TB...SC) for Smart Connect (family ET 200L SC)
 - SC submodules (family ET 200L SC)
 - AS-i slaves (family DP/AS-i Link)
 - S7-300 modules (family ET 200M)

3.4.6 ET 200L and DP/AS-i Link

When configuring the DP slaves ET 200L and DP/AS-i Link (distributed I/O/actuator-sensor interface), the following applies:

- ET 200L can be expanded using Smart Connect (SC) a channel at a time
- DP/AS-i Link is configured with actuator-sensor interface slaves; see below.

When placing a DP/AS-i Link, a configuration table is displayed automatically in which you can place the actuator-sensor interface slaves from the "Hardware Catalog" window.

3.4.7 PROFIBUS PA

In order to configure field devices for the PROFIBUS PA (PROFIBUS for Process Automation), you should note the following:

DP/PA Coupler

You **cannot** configure the DP/PA coupler in Hardware Configuration, because it is "invisible" in the station configuration. You only have to set the transmission rate for the PROFIBUS subnet to 45.45 Kbps in the properties dialog box of the PROFIBUS interface of the DP master or DP slave. The coupler reduces the transmission rate to 31.25 Kbps for the PA field devices.

DP/PA Link

The DP/PA link is a gateway between PROFIBUS DP and PROFIBUS PA. The DP/PA link is a DP slave, which for its part (acting as a kind of "master") "opens" a PROFIBUS PA for connecting PROFIBUS PA devices.

The device can be assigned to a DP master system as a DP slave from the "Hardware Catalog" window.

The representation of the DP/PA link also incorporates a symbol for the DP/PA system as well as the device symbol itself - this is similar to the DP master system. You can assign PA field devices to this symbol.

The PROFIBUS PA must be running at a transmission rate of 45.45 Kbps when you connect PA devices.

Procedure for Configuring the DP/PA Link

1. Install the optional software SIMATIC PDM (PDM=Process Device Manager); this will enable you to configure the PA slaves from the "Hardware Catalog" window at a later stage.
2. Configure a DP master system.
3. Drag the DP/PA link (IM 157) from the "Hardware Catalog" window to the DP master system.
4. Select the DP/PA link; the DP slave structure will be displayed in the lower half of the station window.
5. Slot 2 represents the "master" for the PA devices; double-click slot 2 to configure the PA subnet.
6. Click the "Properties" button (under "Interface") and then select the subnet with the transmission rate of 45.45 Kbps.
7. Then configure the PA devices.
You will find the PA devices in the "Hardware Catalog" window under "PROFIBUS-PA". This entry can only be seen if the SIMATIC PDM optional software package is installed.

3.4.8 HART Modules

HART modules are analog modules to which HART transducers can be connected (HART=Highway Addressable Remote Transducer).

HART modules are required for distributed use with the IM 153-2 (ET 200M).

To **assign parameters to the HART transducers**, start the parameter assignment tool SIMATIC PDM

Requirement:

SIMATIC PDM is installed on the programming device/PC.

Representing HART Measuring Transducers

The transducers for HART modules are represented as interface submodules in the configuration table.

Example: The module is located in slot 4. The transducer for the first channel is then represented as slot 4.1.

To start SIMATIC PDM:

- Double-click one of the "slots" for HART transducers.

As you can also use the SIMATIC PDM tool for assigning parameters to PROFIBUS-PA field devices, you can start it as follows:

- Assign a PA field device to a DP master system by dragging & dropping it from the "Hardware Catalog" window, and then double-click this PA field device.

3.4.9 Configuring Software Redundancy

The configuration of a "warm standby" system consists of:

- Two S7 stations with one PROFIBUS-DP master interface each (each of these interfaces forms its **own subnet**)
- One or more ET 200Ms with IM 153-3 which are connected to **both** subnets.

This configuration guarantees that the standby station takes over the processing of the user program if one station (one of the two DP masters) fails.

Procedure

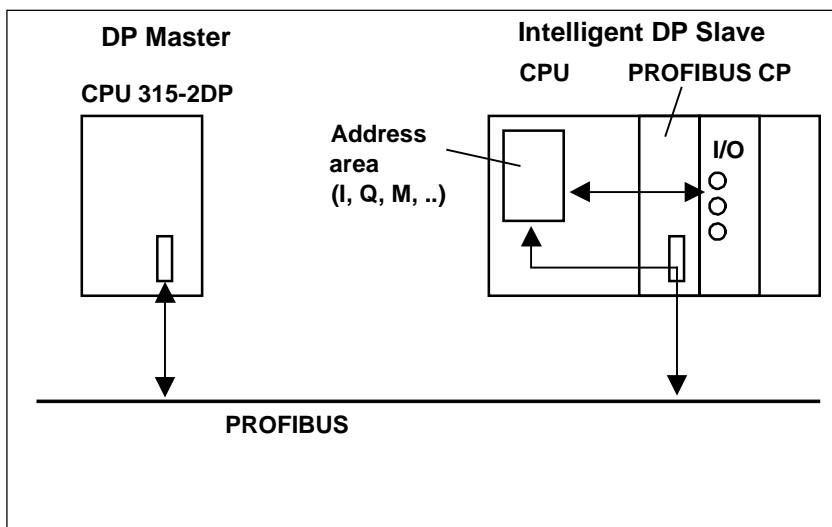
1. Configure the first station completely with all ET 200Ms (IM 153-3).
2. Configure the second station without the ET 200Ms.
3. Copy the ET 200Ms in the first station and paste these DP slaves in the DP master system of the second station (menu command **Edit > Redundant Paste**).

Note

The DP slaves must be configured in each of the two stations which means they appear as two separate objects – although they are physically one and the same DP slave. If you change the settings for one of the ET 200M DP slaves, you must also **copy** this modified DP slave to the other station **again** to ensure consistency.

3.4.10 Configuring Intelligent DP Slaves

An intelligent DP slave does not directly provide the DP master with input and output data from a real input or output, but rather from the CPU which, together with the CP, makes up the DP slave.



Difference: "Normal" DP Slave – Intelligent DP Slave

In a "normal" DP slave such as a compact (ET 200B) or modular (ET 200M) DP slave, the DP master accesses the distributed inputs/outputs.

In an intelligent DP slave, the DP master does not access inputs/outputs of the intelligent DP slave but accesses the address area of the "preprocessing CPU." The user program for the preprocessing CPU must take care of data exchange between the address area and the inputs/outputs.

Note

The configured input/output areas for data exchange between master and slaves must not be "occupied" by I/O modules.


You cannot configure an intelligent DP slave simultaneously as a DP master, meaning that a CPU 315-2 DP configured as a DP slave cannot be a DP master for other DP slaves at the same time.

Two steps are required to integrate an intelligent DP slave into a DP master system:

Configuring the CP 342-5 as a DP Slave

The CP 342-5 can be configured for operation as a DP slave. The station in which the CP was configured is then an "intelligent slave."

Procedure

1. Configure a station with the CP 342-5 DP as DP slave.
(Select the option "DP slave" in the "Operating Mode" tab of the CP.)
2. Configure a DP master (CPU with integrated PROFIBUS-DP interface or CP with PROFIBUS-DP interface) in another station.
3. Drag the CP 342-5 from the "Hardware Catalog" window (**Configured Stations** folder) and drop it onto the symbol for the DP master system ().
A dialog box appears in which you can select configured intelligent DP slaves.
4. Confirm your selection with "OK."
5. Configure the DP IDs and addresses for the input and output areas in the displayed configuration table for the DP slave. To do this, drag and drop the "Universal Module" from the "Hardware Catalog" window (**Configured Stations** folder) into the configuration table (lower half of the station window) and then double-click the corresponding row.


Note

Data exchange between a "preprocessing CPU" and a CP 342-5 DP within the DP slave is described in the NCM S7 for PROFIBUS manual package (particularly in Volume 1).

Configuring the CPU 315-2 DP as a DP Slave

The CPU 315-2 DP can be configured for operation as a DP slave. The station in which the CPU was configured is then the "intelligent slave."


Procedure

1. Configure a station with the CPU 315-2 DP as DP slave.
(Double-click the row 2.1 (interface) in the configuration table and activate the "Use controller as slave" check box in the "Slave Configuration" tab.)
2. Configure a DP master (CPU with integrated PROFIBUS-DP interface or CP with PROFIBUS-DP interface) in another station.
3. Drag the CPU 315-2 DP from the "Hardware Catalog" window (**Configured Stations** folder) and drop it onto the symbol for the DP master system () .
4. Double-click the symbol for the intelligent DP slave and select the "Connection" tab. In this tab you determine which station should represent the intelligent DP slave here.
5. Select the intelligent DP slave and click the "Connect" button.
6. Select the "Slave Configuration" tab and assign master and slave addresses to each other.
7. Confirm your entries with "OK."

Configuring the ET 200X (BM 147/CPU) as a DP Slave

The BM 147/CPU basic submodule is configured like an intelligent DP slave. In contrast to other intelligent DP slaves, the basic submodule can be found in the "Hardware Catalog" window under PROFIBUS-DP/ET 200X/BM147/CPU.

Procedure

1. Configure the DP slave ET 200X (with BM 147/CPU) as an S7-300 station.
 - Create a new station of the type **S7-300** (menu command **Station > New**).
 - Select the directory PROFIBUS-DP/ET 200X/BM147/CPU in the "Hardware Catalog" window.
 - Drag & drop the object "BM 147/CPU" to the empty station window.
 - Configure the DP slave with the required I/O expansion submodules.
 - Save the station (the intelligent DP slave).
2. Configure a DP master (CPU with integrated PROFIBUS-DP interface or CP with PROFIBUS-DP interface) in another station.
3. Drag the DP slave ET 200X (with BM 147/CPU) from the "Hardware Catalog" window (**Configured Stations** folder) and drop it onto the DP master system symbol () .
4. Double-click the symbol for the intelligent DP slave and select the "Connection" tab. In this tab, you can assign the station which is to represent the intelligent DP slave.
5. Select the intelligent DP slave and click the "Connect" button.
6. Select the "Slave Configuration" tab and assign master and slave addresses to each other.
7. Confirm your entries with "OK."

3.4.11 Assigning DP Slaves to SYNC or FREEZE Groups

A DP master with the appropriate function can send the SYNC and/or FREEZE control commands simultaneously to a group of slaves to synchronize the DP slaves. To do this, you must assign the SYNC and FREEZE groups for the DP slaves.

Requirement

You must have created a DP master system.

Procedure

1. Select the DP master system symbol containing the DP slave that you wish to assign to a group.
2. Select the menu command **Edit > Object Properties**.
Result: The "Group Assignment" tab appears with a table in which you can assign the SYNC/FREEZE groups for the DP slave.

Note

You can assign a maximum of one SYNC and one FREEZE group to each DP slave.

Exception: If a CP 3425 is used as DP master, a maximum of eight groups (SYNC and/or FREEZE groups) can be assigned to each DP slave of this master system.

What You Should Know About the SYNC and FREEZE Control Commands

The SYNC and FREEZE commands can be used to perform event-driven synchronization of the DP slaves. The DP master sends the control commands simultaneously to a group of DP slaves of its master system. Those slaves that have failed or are currently reporting diagnostics are ignored.

The requirement for synchronization using control commands is that you have assigned the DP slaves to SYNC and/or FREEZE groups.

SYNC Control Command

The DP master uses the SYNC control command for a group of DP slaves to freeze the states of their outputs at their current values.

In the following frames, the DP slaves store the output data of the DP master, but the states of the DP slaves' outputs remain unchanged.

After every new SYNC control command, the DP slave sets its outputs to the values that it stored as output data of the DP master.

The outputs are only then cyclically updated again when the DP master sends the UNSYNC control command.

FREEZE Control Command

After receiving the FREEZE control command from the DP master, the DP slaves of a group freeze the current state of their inputs and transfer these cyclically to the DP master.

After every new FREEZE control command, the DP slave refreezes the states of their inputs.

The input data are only then cyclically transferred from the DP slave to the DP master when the DP master sends the UNFREEZE control command.

3.5 Configuring Direct Communication Between PROFIBUS Nodes

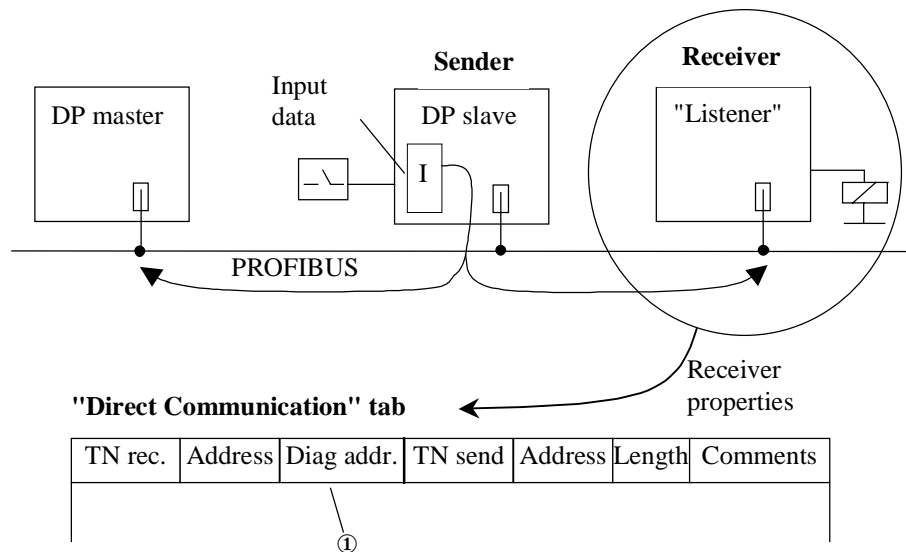
3.5.1 Configuring Direct Communication Between PROFIBUS Nodes

Introduction

"Direct communication" is the term used for a special communication link between two PROFIBUS-DP nodes.

This direct communication link is characterized by the fact that a node "listens" to which input data a DP slave in the same PROFIBUS subnet sends back to its DP master.

This mechanism means that the "listener" (in the figure: the receiver) can react quickly to changes to input variables of remote DP slaves (in the figure: sender).



- ① The receiver CPU uses the receiver diagnostics address to report sender failure (OB 86, module rack / DP slave failure). The sender's diagnosis can also be displayed under this address.

Properties of the Participating PROFIBUS Nodes

Receiver:

The receiver must support the configuration of direct communication links. When configuring nodes in STEP 7 this means: by double-clicking on the DP interface in the configuration table (Configuring Hardware) you can access the "Direct Communication" tab.

Examples: You can configure the following as a receiver: CPU 315-2 DP. The role played by the receiver on the PROFIBUS (DP master or DP slave) is not relevant.

Sender (DP slave):

The sender must make its input data available to the DP master **and** the "listener" (receiver). STEP 7 "knows" which DP slaves have this capability and only offers these DP slaves for selection.

DP master:

The DP master as a parameter master must be in the position to allow its DP slaves to take part in direct communication. Currently these are the newest CPUs with DP interface (S7-300) and the newest interface modules with DP interface (compare the performance data of the relevant components).

Starting Configuration

1. Double-click the DP interface of the configured receiver.
2. Select the "Direct Communication" tab.
3. Click the "New" button to specify the sender and the address ranges (peripheral inputs) for sender and receiver.

You will find more information in the online help for this tab.

3.6 Working with *.GSE Files

3.6.1 Working with *.GSE Files

Device Database File

All the properties of a DP slave are saved in a device database (*.GSE) file. *STEP 7* requires a *.GSE file for every DP slave in order that the DP slave can be selected in the module catalog. The manufacturer supplies a *.GSE file for non-Siemens devices that are DP slaves.

3.6.2 Importing a *.GSE File

From STEP 7 V4.02, the *.GSE files are not only saved in the directory for the application "Configuring Hardware" but also in the project, meaning all the relevant information required to represent DP slaves (including the symbols for DP slaves) is available in the saved project.

If a station has to access the *.GSE files stored in the project, this is known as **importing the station *.GSE**.

When configuring hardware you can use the menu command **Options > Import Station *.GSE Files** to import the *.GSE files and DP slave symbols (only) available in the project into the STEP 7 GSE directory in order to use them for other projects.

3.6.3 Installing a *.GSE File

If a DP slave does not appear in the "Hardware Catalog" window, you must install the corresponding *.GSE file supplied by the manufacturer:

1. Select the menu command Options > Install New *.GSE Files.
2. In the dialog box that appears, open the drive/directory containing the corresponding *.GSE file.

Result: The DP slave is entered in the "Hardware Catalog" window under "PROFIBUS-DP\Other Field Devices" and is then available to be used for configuring.

Overwriting *.GSE Files

To represent DP slaves STEP 7 uses device database (*.GSE) files and symbols which are installed in STEP 7, meaning:

- They were installed automatically with STEP 7 or
- They were installed at a later date using the menu command **Options > Install New *.GSE Files** or **Options > Import Station *.GSE Files** in STEP 7.

When you install or import the files at a later date, the existing *.GSE files/symbols are not completely deleted but are stored in the following backup directory:

\\Step7\S7data\Gsd\Bkp[No.],

where [No.] is a serial number which STEP 7 assigns automatically.

Restoring Overwritten *.GSE Files

To restore *.GSE files/symbols you overwrote accidentally, proceed as follows:

1. Select the menu command Options > Install New *.GSE Files.
2. In the following dialog box, navigate to the directory \\Step7\S7data\Gsd\Bkp[No]. Make sure that you select the required backup directory (use the Explorer to find the directory with the correct date/time).
3. Click the "Open" button.

4 Saving, Importing and Exporting a Configuration

4.1 Saving a Configuration and Checking the Consistency

To save a configuration with all set parameters and addresses, select the menu command **Station > Save** or **Station > Save and Compile**.

If you use the menu command **Station > Save and Compile**, the configuration is saved in the active project as a "Station" object and if valid system data blocks (SDB) could be created, they are stored in the (offline) "Blocks" folder for the associated modules ("SDB carrier," for example, CPU). The system data blocks are represented by the "System Data" folder/symbol.



To be able to save incomplete configurations, select the menu command **Station > Save**. Using this command no system data blocks are created when saving. The save procedure takes less time than if you save and compile, but you should be aware that there may be inconsistencies between the configuration saved in the "Station" object and the configuration saved in the system data.

Before downloading, you should check your station configuration for errors using the menu command **Station > Consistency Check**.

4.2 Importing and Exporting a Configuration

Introduction

From STEP 7 V5 you can handle station configurations not only together with the whole project (for example, save or open them), but also export and import them independently of the project in text form (ASCII file).

Applications

- You can distribute files by electronic means (for example, by e-mail)
- You can save files for use with future STEP 7 versions
- You can print export files using word processing systems or process them for documentation purposes.

What is exported/imported?

During hardware configuration the only data which can be exported or imported are those data required for the configuration and parameter assignment of modules.

The following data are **not** acquired:

- Data which are managed via other applications (for example, symbols, programs, connections, shared data)
- The CPU password which was set
- Network configurations (for example, assignments to subnets, bus parameters)
- Data not specific to one station (for example, links to intelligent DP slaves)

Note

If your configuration contains modules from earlier optional packages, it is possible that not all module data will be acquired when you use the "Export Station" function. In this case, you should check that the module data are complete after importing.

Export File

You can set what is stored in the exported text file and in what form it is stored when you export (**Station > Export** menu command):

- Legible or Compact Format
- The name of the file can be (*.CFG) freely selected
- Default values for module parameters can be left out (STEP 7 "knows" the default values and adds them from the internal module data when you import)

Procedure (Exporting)

1. Open a station configuration or save the station configuration you are currently editing (**Station > Save** menu command).
2. With a station configuration open, select the menu command **Station > Export**.
3. In the dialog box that appears, enter the path and name of the export file, the format, and other options.
4. Confirm your settings with "OK."

Procedure (Importing)

1. With an empty station configuration open, select the menu command **Station > Import**.
2. In the dialog box that appears, navigate to the text file you want to import.
3. Confirm your settings with "OK."
On importing, STEP 7 checks the imported file for errors and consistency and outputs messages.

Importing into an Existing Station

You can also import a station into an open station configuration. On importing, STEP 7 queries whether already configured modules/interface submodules should be overwritten. For every component you can decide whether you want to keep it or overwrite it.

When a component is overwritten, all settings (parameters) in the import file become valid. Any settings that are not included in the import file remain in the station configuration.

5 Downloading and Uploading a Configuration

5.1 Downloading a Configuration to a Programmable Controller

Tip

Before downloading, use the **Station > Check Consistency** menu command to make sure there are no errors in your station configuration. STEP 7 then checks to see whether downloadable system data can be created from the present configuration. Any errors found during consistency checking are displayed in a window.

Requirements for Downloading

- The programming device (PG) is connected to the MPI interface of the CPU using an MPI cable.
- In a networked system (programming device is connected to a subnet): All modules in a subnet must have different node addresses and the actual configuration must match the network configuration you created.
- The present configuration must match the actual station structure. A configuration can only be downloaded to the station if it is consistent and free of errors. Only then can system data blocks (SDBs) be created which can in turn be downloaded to the modules.
- If the station structure contains modules that were configured and assigned parameters using optional software packages: The optional package must be authorized.

Procedure

- Select the menu command **PLC > Download To Module**.
STEP 7 guides you by means of dialog boxes to the result.

The configuration for the complete programmable controller is downloaded to the CPU. The CPU parameters become active immediately. The parameters for the other modules are transferred to the modules during startup.

Note

Partial configurations, for example, the configuration of individual racks, cannot be downloaded to a station. For consistency reasons, STEP 7 always downloads the whole configuration to the station.

Changing the CPU Operating Mode During Downloading

When you trigger the function **PLC > Download**, you can execute the following actions on the programming device guided by the dialog boxes:

- Switch the CPU to STOP
(if the mode selector is set to RUN-P or the connection to the CPU is authorized by password)
- Compress the memory
(if not enough continuous free memory is available)
- Switch the CPU back to RUN

5.2 Uploading a Configuration from a Station

Requirement

You have used an MPI cable to connect the programming device (PG) to the MPI interface of the CPU.

Tips

Upload stations to a newly created, empty project.

Stations that are dependent on other stations in a particular way (I slave on a DP master station, receiver and sender in a direct communication link) should always be uploaded together to one project. Reason: Without the particular "partners" for a station of this type, the project would remain inconsistent.

Procedure

1. Select the menu command **PLC > Upload**.
2. The dialog box to open the configuration appears.
3. Select the project in which the configuration will be stored later and confirm with "OK."
4. In the dialog box which then appears, set the node address, rack number, and slot in the module from which the configuration should be read (generally CPU). Confirm with "OK."

You can use the **Station > Properties** menu command to assign a station name to this configuration and then store it in the default project (**Station > Save** menu command).

6 Synchronuous Operation of Multiple CPUs

6.1 What You Should Know About Multicomputing

6.1.1 What You Should Know About Multicomputing

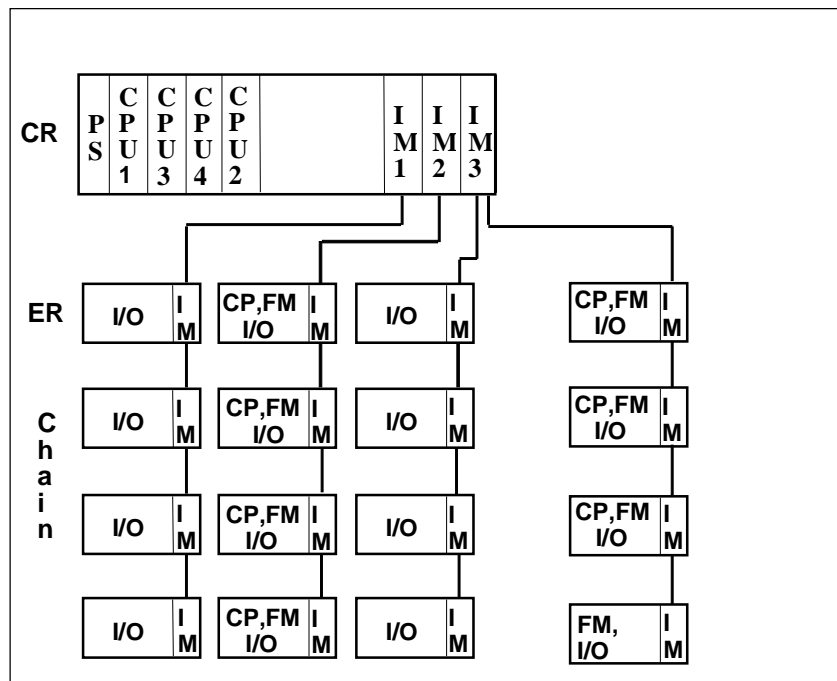
What is Multicomputing Operation?

Multicomputing means the simultaneous operation of more than one CPU with multicomputing capability (up to a maximum of four) in one central rack of the S7-400.

The participating CPUs automatically change their operating modes synchronously, meaning the CPUs start up together and go into STOP mode together. The user program for each CPU executes independently of the user programs in the other CPUs. This means control tasks can be run in parallel.

Example

The following figure shows a programmable controller that will operate in multicomputing mode. Each CPU can access the modules assigned to it (FM, CP, SM).



Difference Between Multicomputing and Operation in Segmented Racks

Simultaneous unsynchronized operation of more than one CPU in a segmented rack CR2 (physically segmented, cannot be set by user) is also possible. This is, however, not multicomputing. The CPUs in a segmented rack form their own independent subsystem and behave like single processors. There is no shared address area.

"Multicomputing mode" and "unsynchronized operation in a segmented rack" at the same time is not possible.

6.1.2 Special Features

Slot Rules

In multicomputing mode up to four CPUs can be inserted simultaneously in a central rack in any order.

Bus Connection

The CPUs are interconnected via the communication bus (corresponds to a connection via MPI).

Behavior During Startup and Operation

During startup the CPUs in multicomputing operation check automatically whether they can synchronize. Synchronization is only possible:

- If all (and only) the configured CPUs are inserted and not defective
 - If correct configuration data (SDBs) were created and downloaded for all inserted CPUs.
- If one of these prerequisites is not met, the event is entered in the diagnostic buffer under the ID 0x49A4. You will find explanations of the event IDs in the reference online help on standard and system functions (SFBs/SFCs).

When the CPUs exit STOP mode, the startup types are compared (COLD RESTART/WARM RESTART/HOT RESTART). This ensures that all the CPUs in the programmable controller execute the same type of startup and all CPUs have the same operating mode.

Address and Interrupt Assignment

In multicomputing mode the individual CPUs can access the modules assigned to them during configuration with STEP 7. The address area of a module is always exclusively assigned to a CPU.

An interrupt input is assigned to every CPU. Interrupts received at this input cannot be received by the other CPUs. The assignment of the interrupt line is made automatically during parameter assignment of the modules.

The following rules apply to interrupt servicing:

- Hardware interrupts and diagnostic interrupts are sent to only one CPU.
- If there is a module failure, the interrupt is serviced by the CPU to which the module was assigned with STEP 7.
- If a rack fails, OB86 is called on every CPU.

You will find more detailed information on OB86 in the reference online help on organization blocks.

6.1.3 When to Use Multicomputing

Multicomputing has advantages in the following situations:

- When your user program is too large for one CPU and memory is used up, distribute your program among more than one CPU.
- If part of your system must be processed quickly, take these program sections out of the main program and run them on a separate fast CPU.
- If your system consists of various parts that can be clearly delineated and can be controlled relatively autonomously, run the program for system section 1 on CPU 1 and system section 2 on CPU 2 etc.

6.2 Configuring Multicomputing Operation

6.2.1 Configuring Multicomputing Operation

Setting Multicomputing Operation

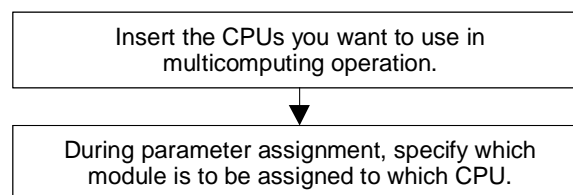
Multicomputing operation results implicitly when you insert a second (third or fourth) multicomputing CPU in a rack suitable for this kind of operation (for example, the rack UR1). When a module is selected, the info text in the "Hardware Catalog" window tells you whether the CPU has multicomputing capability.

Requirements

Before you can configure modules in your programmable controller for multicomputing mode, the following conditions must be satisfied:

- You must have set up your programmable controller as described in the "S7-400, M7-400 Programmable Controllers, Hardware and Installation" manual.
- You must have opened the configuration table in the project window by double-clicking the "Hardware" object.
- You must have arranged a rack in the station window and the rack is shown as being open (the rack slots are visible).

Basic Procedure



Note when Downloading and Uploading

Only the complete station configuration should be downloaded to all CPUs. This avoids inconsistent configurations.

When uploading to a programming device, the station configuration is loaded from all programmable modules, one after another (CPU by CPU). You have the option of aborting the upload process even if not all the configuration data (SDBs) were uploaded. In this case, parameter assignment information will be lost.

6.2.2 Configuring Modules for Multicomputing Operation

To configure the programmable controller in multicomputing mode, proceed as follows:

1. Use the drag & drop function to copy the CPUs you want to work in multicomputing operation from the "Hardware Catalog" window to the appropriate rows of the rack.
2. Double-click on a CPU and set the CPU number in the "Multicomputing" tab (when you insert the CPU, the CPU numbers are assigned automatically in ascending order).
3. For all modules to be assigned to CPU1, proceed as follows:
 - Arrange the modules at the intended position in the rack.
 - Double-click on the module and select the "Addresses" tab.
 - In the "CPU No." box select CPU 1.

Note: The CPU assignment is displayed for modules that can trigger interrupts in the "Inputs" or "Outputs" tab as the "Target CPU for interrupt."

4. Repeat the steps listed under 3 for the modules that are to be assigned to the remaining CPUs.

6.2.3 Displaying the CPU Assignment

You have a choice of two methods of highlighting the modules that are assigned to a specific CPU:

- Select the menu command **View > Filter > CPU No. x - Modules** (x = CPU number).

All modules that are not assigned to this CPU are grayed out (exception: distributed I/O modules, interface modules, and power supplies).

- Select the relevant CPU and select the pop-up menu command **Filter Assigned Modules**.

Note

The filter you set has no effect on the print function or the "Address Overview" dialog box.

You can modify the CPU assignment via the "Addresses" tab (exception: interface modules and power supplies).

6.2.4 Changing the CPU Number

If you have inserted several CPUs and want to change the CPU number, proceed as follows:

1. If **four CPUs** are inserted: Delete one of the inserted CPUs.
If two or three CPUs are inserted: Continue with the next step.
2. Double-click the CPU whose number you want to change.
3. Select the "Multicomputing" tab.
4. Select the required CPU number.

6.3 Programming CPUs

6.3.1 Programming CPUs

Programming

Programming for the multicomputing mode is essentially the same as programming a single CPU.

Extra steps are, however, necessary if you want to synchronize the CPUs so that they react to events together.

Calling SFC35

If you want all the CPUs to react to events (for example, interrupts) together in the multicomputing mode, you program an SFC35 "MP_ALM" call. Calling SFC35 triggers a multicomputing interrupt that causes a synchronized request for OB60 on all CPUs. This OB contains local variables that specify the triggering event in greater detail.

When SFC35 is called, the information about the events is transferred to all CPUs in a job identifier. The job identifier allows 16 different events to be distinguished.

When they service the multicomputing interrupt, both the sending user program and the user programs on the other CPUs check whether or not they recognize the job and then react as programmed.

You can call SFC35 at any point in your program. Since the call is only of practical use in RUN mode, the multicomputing interrupt is suppressed if it is triggered in STARTUP mode.

The multicomputing interrupt can only be triggered again after the current multicomputing interrupt has been serviced (acknowledged).

You will find more detailed information on SFC35 in the reference online help on SFBs/SFCs .

Programming OB60

You can program a specific OB60 for each separate CPU and download it to the CPU. This means that the execution times can differ from CPU to CPU. This leads to the following behavior:

- The interrupted priority classes on the CPUs are continued at different times.
- A multicomputing interrupt is not serviced if it occurs during the execution of OB60 on any of the CPUs. A message is, however, generated and you can check this and react accordingly.

If OB60 is not loaded on one of the CPUs, this CPU returns immediately to the last priority class and continues the program there.

You will find more detailed information on OB86 in the reference online help on organization blocks .

7 Configuring Networked Workstations

7.1 Networking Stations

7.1.1 Networking Stations within a Project

Context: Network Configuration and STEP 7 Projects

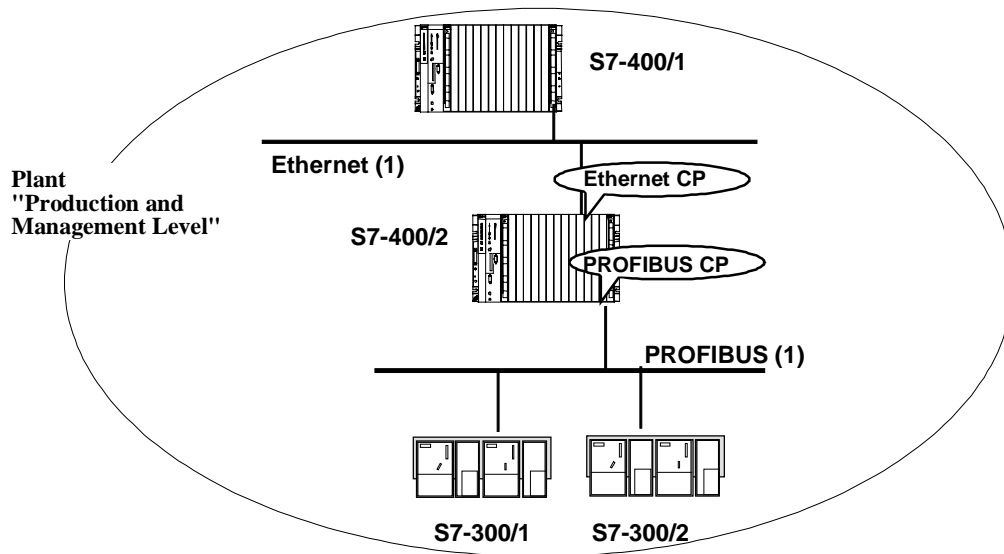
Subnets lie directly beneath a project in the object hierarchy and can therefore only be managed within a project. You can, however, connect nodes together that were configured in different projects.

If possible, you should create and configure nodes that you want to connect in networks in the same project. Only then can STEP 7 check your entries (addresses, connections) for consistency.

Subnets and Stations

You can create the subnets and stations in a STEP 7 project and then configure the stations for communication very easily.

As a result of the different tasks of the stations or the fact that the plant has increased in size and scope, it may be necessary to run a number of subnets. These subnets can also be managed in one project. A station can be assigned to a number of subnets by assigning the communication nodes (for example, CPs) accordingly.



Everything in one STEP 7 Project

7.1.2 Properties of Subnets and Communication Nodes

Setting the Properties of Subnets and Communication Nodes in a Project

It does not matter whether you are intending to communicate in the network using global data or communication connections: the basis for communication is always a configured network.

With STEP 7:

- You create a graphic view of your network (comprising one or more subnets)
- You set the subnet properties/parameters for each subnet
- You set the node properties for each networked module
- You document your network configuration.

The following table shows how you are given support by STEP 7 when configuring your communication task.

Communication Method	Configured How?	Remarks
PROFIBUS-DP	Configuring the hardware	Also possible in NetPro
Actuator-sensor interface (AS-i)	Configuring the hardware	Linked to S7 stations via the DP/AS-i Link
Communication via non-configured connections	Configuring the hardware	Set the properties of the MPI subnet and the MPI nodes
Communication via configured connections	NetPro (Configuring Networks and Connections)	S7 and PTP connections can be configured with the STEP 7 Standard package. Optional packages are required for other connection types (for example, FMS for PROFIBUS).
Global data communication	Defining Global Data	Set the properties of the MPI subnet and the MPI nodes and configure address areas for data exchange in the GD table

7.1.3 Rules for Network Configuration

You should observe the following rules for configuring networks:

Every node in a subnet must have a different node address.

CPUs are shipped with the default node address 2. However, you can only use this address once in a subnet, so you will have to change the default address for any other CPUs.

For S7-300 stations, the following applies: When planning the MPI addresses for a number of CPUs you must leave "MPI address gaps" for FMs and CPs with their own MPI addresses to avoid double address assignments.

Only when all the modules in a subnet have unique addresses and when your actual structure matches the network configuration you have created should you load the settings via the network.

Assigning MPI Addresses

- Assign the MPI addresses in ascending order.
- Reserve the MPI address 0 for a programming device.
- You can connect up to 127 (addressable) nodes in an MPI network.
- All MPI addresses in an MPI subnet must be unique.

Refer to the S7-300 or S7-400 Hardware Installation Manuals for other rules concerning the installation of a network.

Assigning PROFIBUS Addresses

- Every DP master and DP slave in the PROFIBUS network must be assigned a unique PROFIBUS address in the range 0 through 125.
- Assign the PROFIBUS addresses in ascending order.
- Reserve the "0" PROFIBUS address for a programming device that you later connect briefly to the PROFIBUS network for service purposes.

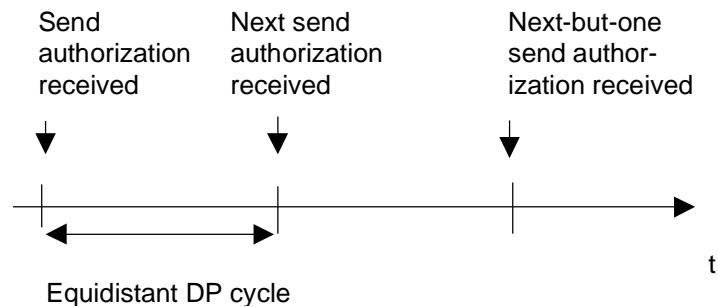
7.2 Setting Equidistant Bus Cycles for PROFIBUS Subnets

7.2.1 Setting Equidistant Bus Cycles for PROFIBUS Subnets

Introduction

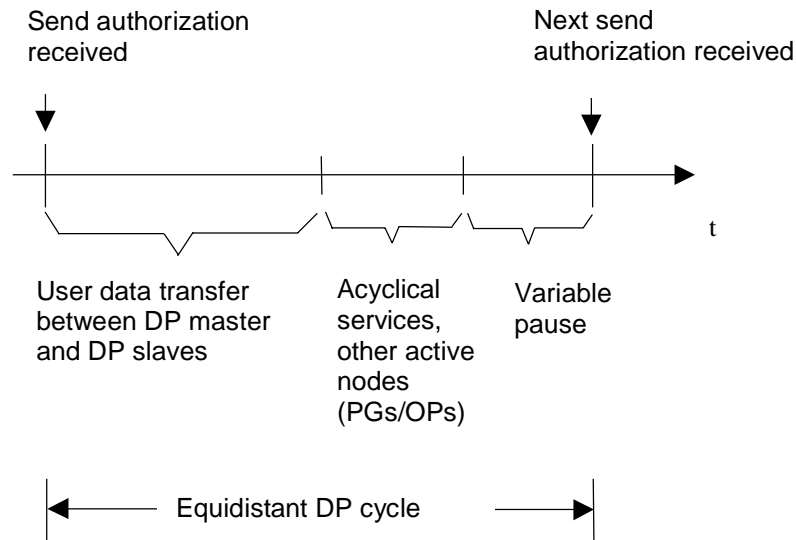
For PROFIBUS subnets you can set equidistant (equal length) bus cycles in STEP 7.

Equidistance here means that the time interval between consecutive send authorizations for the same active node (for example, DP master) is constant.



Bus Cycle Time

The following figure shows how the time for a bus cycle is made up.



The "variable pause" shown in the figure is always minimal if communication jobs, for example, for other active nodes are still pending. The master (also known as the equidistance master) controls the communication parts so that the same duration for a bus cycle is always achieved.

The equidistance master must be a class 1 DP master. This means a PG/PC can never be an equidistance master.

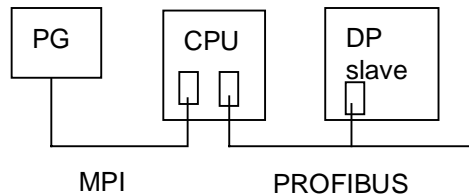
STEP 7 calculates a recommended time for the "Equidistant DP cycle (ms)" based on:

- The PROFIBUS configuration (number of configured nodes, number of programming devices etc.)
- Other information for the calculation which can be specified as an option (for example, any additional unconfigured programming devices to be taken into account)

You can correct this time but not below the calculated and displayed minimum value.

Influence of Connected Active Nodes (PGs/PCs and I Slaves)

A PG/PC must only be taken into account if it is connected directly to the PROFIBUS via its PROFIBUS interface. It does not need to be taken into account if it is connected via the multipoint interface of the CPU, as shown in the following figure.



If intelligent DP slaves (for example, CPU 315-2DP) are connected, the time for the equidistant DP cycle should be calculated generously.

Equidistance Behavior

You can set how closely or generously STEP 7 calculates the recommended time for the "Equidistant DP cycle" under the equidistance behavior; these settings reflect the knowledge gained by experience of different applications:

- **Fail-safe:** if the time for the equidistant DP cycle should not be undershot under any circumstances (for example, when DP slaves fail or an increased load caused by additional programming devices connected)
- **Standard:** if the time for the equidistant DP cycle should only be exceeded in extreme situations
- **Speed-optimized:** if the time for the equidistant DP cycle must be calculated very closely owing to the process and if frequent exceeding of this time can be tolerated.

In this case, no other nodes can be connected to the bus apart from the DP master and the DP slaves (only user data traffic).

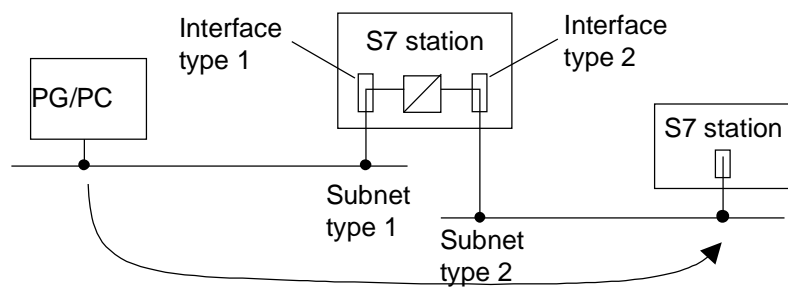
7.3 Networking Stations that Represent Network Gateways

7.3.1 Networking Stations that Represent Network Gateways

From STEP 7 V5 it is possible for you to access S7 stations online with the programming device/PC beyond the limits of a subnet in order, for example, to download user programs or a hardware configuration or to execute test and diagnostics functions. You can connect a programming device to any position in the network and establish an online connection to all stations that can be accessed via network gateways.

Network Gateway

The gateway from a subnet to one or more other subnets lies in a SIMATIC station that has interfaces to the respective subnets.



Requirements

- The modules in the station must be capable of routing (CPUs or CPs)
- The network configuration must not go beyond the limits of the project
- The modules must be loaded with the configuration information that contains the current "knowledge" of the entire network configuration for the project. Reason: All the modules involved in the network gateway must receive information about which subnets can be accessed via which routes (= routing information).

Additional Information for Network Gateways

In addition to node address, subnet properties, and connections, from STEP 7 V5 routing information is also generated that must be loaded onto the corresponding modules.

Routing information includes:

- Module interfaces
- Assignment to connected subnets
- The next network gateways in order to be able to access a remote subnet from one of the connected subnets

This information is generated automatically by STEP 7 when the network or station configuration is compiled (menu command: ... > **Save and Compile**).

Which Modules or Stations Must Be Loaded After a Change to a Network Configuration?

If you change a configuration as follows you have to reload
Delete or add a network connection to a station (station equals network gateway)	All network gateways
Modify an interface address on the subnet (station equals network gateway) or plug a module with its own MPI address into an S7-300 station in such a way that the MPI address of a network gateway (next module inserted) is changed	Network gateways on the same subnet
Add or delete a network gateway	All network gateways
Insert a module with a network connection in another slot (station equals network gateway)	All modules for this station
Add a subnet	-
Delete a subnet (where network gateways are configured on this subnet)	All network gateways
Change a subnet ID	If any network gateways are connected to this subnet: All network gateways

Subnet ID for an Online Connection via Network Gateways

If the network configuration together with all the routing information was downloaded to the affected stations, you must also specify a subnet ID to access the remote station.

The subnet ID that is requested by STEP 7 using dialog boxes is formed from two numbers:

- A number for the project
- A number for the subnet

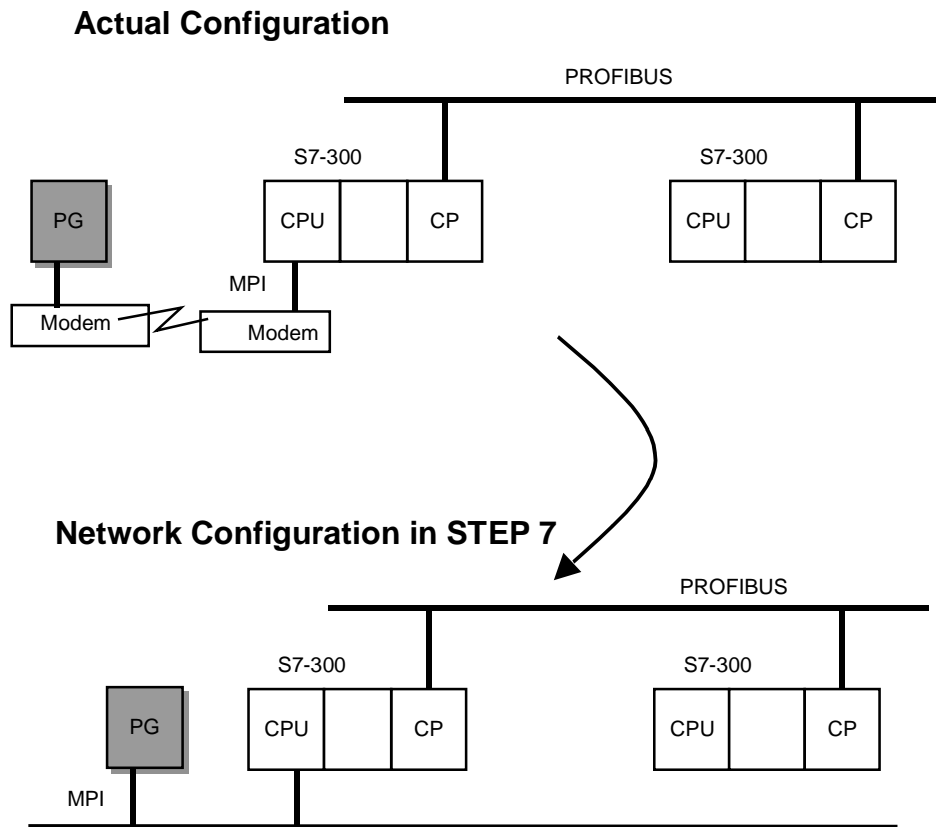
Both numbers can be determined via the properties dialog box of the subnet with an existing network configuration. If you want to go online with a programming device without a consistent project, you must know the subnet ID. The subnet ID is printed out with the network configuration.

7.3.2 Programming Devices / PCs Connected to a Subnet via TeleService or WAN

A programming device or PC that accesses nodes in a remote subnet via TeleService or WAN (Wide Area Network) is dealt with as follows in the network configuration:

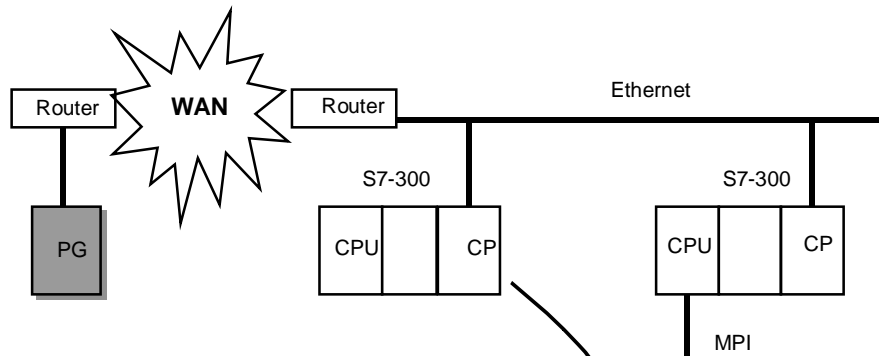
The "PG/PC" object is connected directly to the remote subnet in the network configuration of STEP 7. The network gateway via a TS adapter or router is not visible in the configuration.

Example: Connecting a Programming Device via TeleService

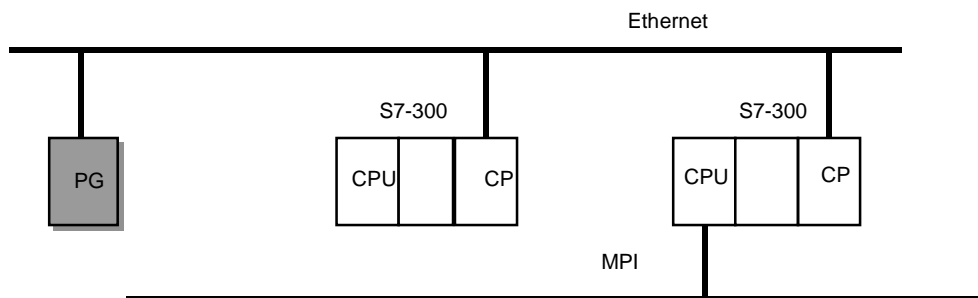


Example: Connecting a Programming Device via WAN

Actual Configuration



Network Configuration in STEP 7



7.4 Networking Stations from Different Projects

7.4.1 Networking Stations from Different Projects

Introduction

In complex networked systems, it may be advantageous to manage the stations in more than one project.

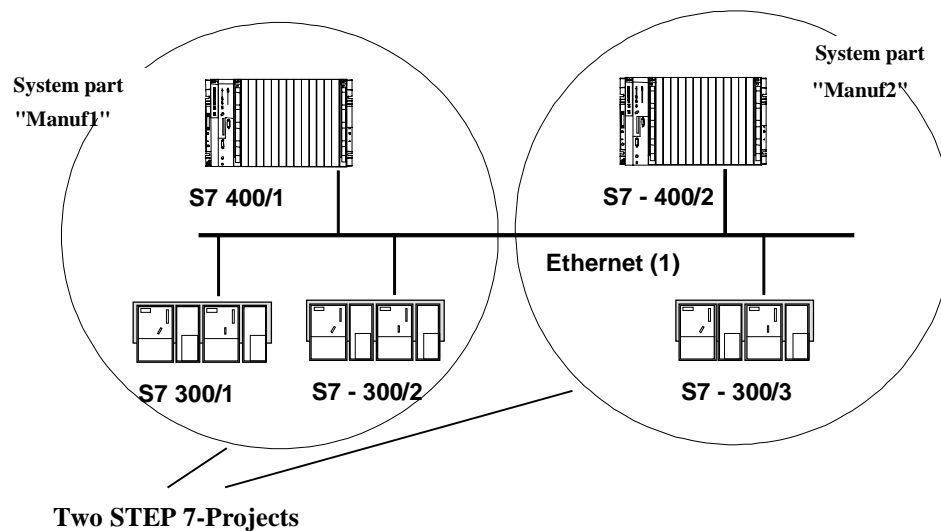
In the figure below, a networked system is divided into two system parts (projects) "Manuf1" and "Manuf2."

The problem: for the project "Manuf1," stations that were configured in the project "Manuf2" are unknown.

Consequences

- You must insert the symbol "Other Station" in the project "Manuf1" to represent a station in the project "Manuf2." The "Other Station" as a "stand-in object" is restricted to the properties that are relevant for the network view.
- You must program the subnet to which both parts of the system are connected twice in identical form: once in the project "Manuf1" and once in the project "Manuf2."

The responsibility for the consistency of the network data in the different projects lies with you in this case; STEP 7 cannot ensure consistency "beyond project boundaries."

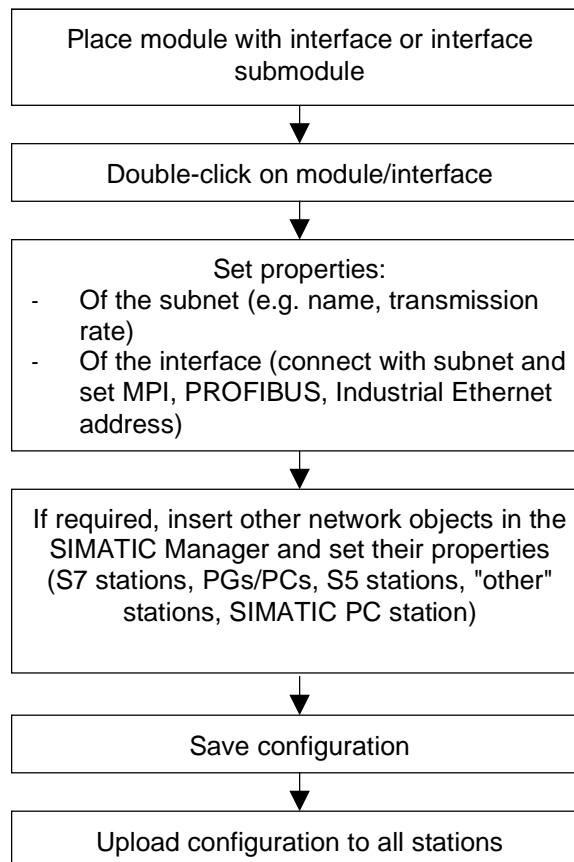


8 How to Configure and Save a Subnet

8.1 Procedure for Configuring a Subnet

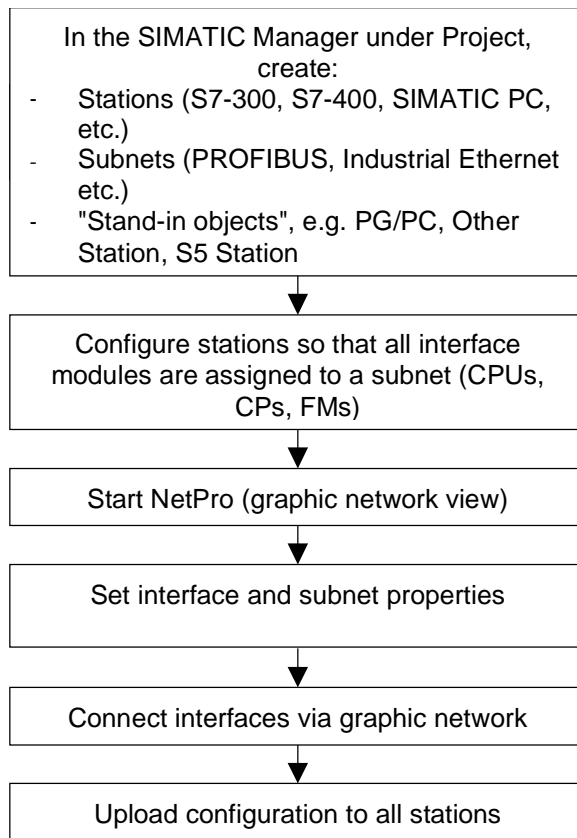
Method 1: Configuring Hardware

You have the possibility of creating subnets and connecting modules (or rather, their interfaces) to a subnet when you configure a station.



Method 2: Configuring Networks

For complex networked plants it is more advantageous to work in the network view.



Expanding the Network Configuration in NetPro

You have the possibility in NetPro of inserting all network objects such as subnets or stations by dragging them from a catalog and dropping them in the network view.

What else is to be done after you have inserted the objects:

- Set the object properties by double-clicking the objects
- For an inserted station: start the Hardware Configuration application by double-clicking the station and place the modules.

Opening the Graphic Network View (Starting NetPro)

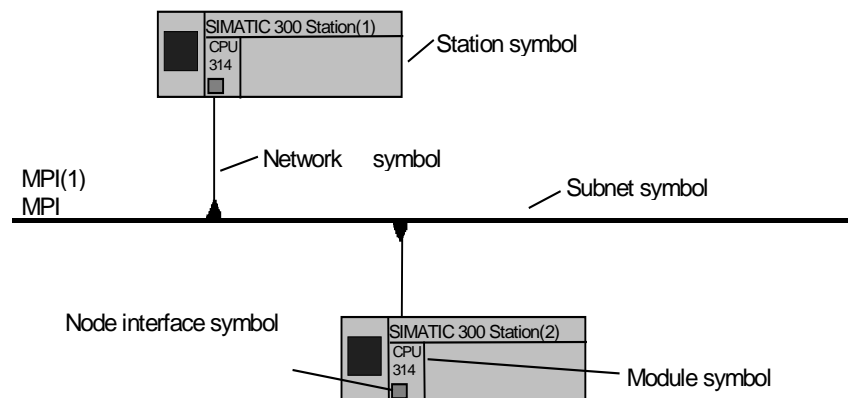
You can use the following methods to start the network configuration application:

From the SIMATIC Manager	From Configuring Hardware
<ol style="list-style-type: none"> 1. Open the project 2. Double-click a subnet symbol (having created a subnet using the menu command Insert > Subnet > ... if necessary) <p>Alternatively you can also double-click the "Connections" object (icon found under a module that is a connection end point, for example, a CPU). In this case the connection table for the module is opened for editing when NetPro is started.</p>	<ol style="list-style-type: none"> 1. Menu command Options > Configure Network

Example of a Graphic Network View

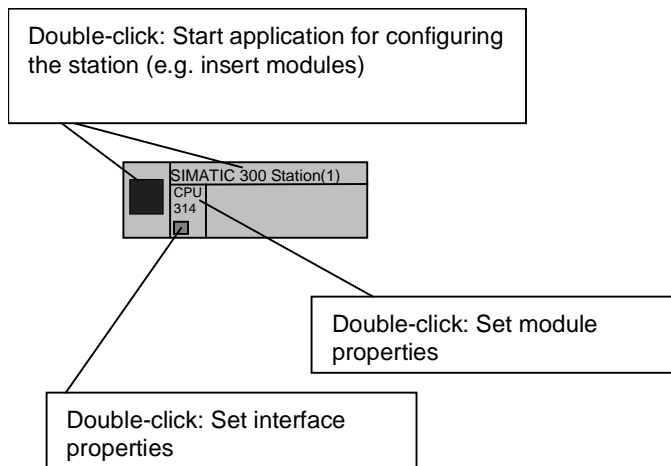
When you have opened the network configuration application, the window for the graphic view of the network is displayed. The first time you select it, the following are visible:

- All the existing subnets created in the project
- All the existing stations configured in the project



Editing a Station in NetPro

If you double-click an area of the station symbol you can further edit the station:



8.2 Creating and Assigning Parameters to a New Subnet

Requirement


NetPro must be open.

Note

STEP 7 automatically and centrally sets consistent subnet properties (e.g. transmission rate) for all nodes in a given subnet.

If you set or modify subnet properties in STEP 7, you must make sure that each node in the system subnet adopts these settings (Downloading a Configuration to a Programmable Controller).

Procedure

1. If the "Catalog" window is not visible:
Open the "Catalog" window using the menu command **View > Catalog**.
2. Click on "Subnets" in the "Catalog" window.
3. Click on the required subnet, hold the mouse button pressed, and use the drag & drop function to copy the subnet to the window for the graphic network view. Invalid positions for subnets in the view window are shown by a  sign instead of the cursor.
Result: The subnet appears as a horizontal line.
4. Double-click the symbol for the subnet.
Result: The properties dialog box for the subnet is displayed.
5. Assign parameters to the subnet.

Tip:


You can open an information window giving details about the subnet properties by holding the mouse on the symbol for the subnet.

8.3 Creating and Assigning Parameters to a New Station

Requirement

NetPro must be open.

Procedure

1. If the "Catalog" window is not visible:
Open the "Catalog" window using the menu command **View > Catalog**.
2. Click on "Stations" in the "Catalog" window.
3. Click on the required type of station, hold the mouse button pressed, and use the drag & drop function to copy the station to the window for the graphic network view.
Invalid positions for stations in the view window are shown by a  sign instead of the cursor.
4. Double-click the station (station symbol or station name).
You **can** now enter the whole hardware configuration for the station and assign its parameters, but you **must** assign the CPU, and any FMs and CPs to a suitable slot. Only these modules can be networked and appear in the graphic network view.
5. Save the hardware configuration.
6. Switch back to NetPro using the taskbar (in Windows 95).
Result: The node interfaces available are displayed in the station.

Important:

Before you switch between the station configuration and NetPro, you must save the data you entered, otherwise the database will not be updated.

Tip



You can open an information window giving details about the station properties by holding the mouse on the symbol for the station.

8.4 Creating and Assigning Parameters to a Network Connection

Requirement

NetPro must be open and the existing configured stations must be visible.

Procedure

1. Click on the symbol for the interface of a node () , hold the mouse button pressed, and drag the mouse pointer to the subnet.
Invalid connection options (for example, connecting an MPI interface to an Ethernet-type subnet) are shown by a  sign instead of the cursor in the view window.
Result: The network connection appears as a vertical line between the station/DP slave and the subnet.
2. Double-click the symbol for the network connection or the symbol for the interface.
Result: The properties dialog box for the subnet node is displayed.
3. Assign the node properties (for example, the name and address of the node).

Tip


You can open an information window giving details about the interface properties (module name, subnet type, and, if networked, the node address) by holding the mouse on the interface symbol.

8.5 Creating and Assigning Parameters to a New DP Slave

Requirement:

- You must have assigned a DP master to a station when you configured the hardware in the configuration table.
- DP slaves are displayed in the network view (if not: select the menu command **View > DP Slaves**).

Procedure

1. If the "Catalog" window is not visible:
Open the "Catalog" window using the menu command **View > Catalog**.
2. In the network view, select the DP master in a station to which you want to assign the DP slave.
3. In the "Catalog" window click on the required DP slave (under "PROFIBUS-DP"), hold the mouse button pressed, and use the drag & drop function to copy it to the window for the graphic network view.
Invalid positions for DP slaves in the view window are shown by a  sign instead of the cursor.
Alternatively you can also double-click the required DP slave in the "Catalog" window.
4. In the properties dialog box which opens automatically, assign a node address for the DP slave.
Result: The DP slave appears in the network view together with its network connection.
5. To assign parameters/set addresses: double-click the DP slave.
Result: Configuring Hardware is started and the DP slave is selected.
6. Set the properties for the DP slave.

Tip

You can open an information window giving details about the DP slave properties by holding the mouse on the symbol for the DP slave.

8.6 Creating and Assigning Parameters to Programming Devices/PCs, 'Other' Stations, and S5 Stations

Overview

What do you do with network nodes that cannot be configured in the current STEP 7 project such as programming devices (PGs), operator stations (OPs), devices made by other manufacturers with their own configuration tool, or S5 devices?

These devices are represented in NetPro by objects such as PG/PC, "other station," and S5 station.

Selecting the Correct Object


The following table shows which object should be inserted in which case:

Object	Purpose	Remarks
PG/PC	To represent in the network view your "own" programming device from which you want to access every node in the subnet online.	Via the "Assignment" tab you can establish an assignment between your PG/PC (programming device) and the "PG/PC" object inserted in NetPro. In NetPro the symbol for the PG/PC is specially highlighted.
	For PGs/PCs that are the target for an S7 connection.	For PGs/PCs with S7-SAPI interface
SIMATIC PC station	For PC stations that are the end point of a (two-way) S7 connection; also suitable for redundant S7 connections.	The end point of a connection in SIMATIC PC stations is an application such as S7-SAPI ** or WinCC. For a SIMATIC PC station a number of connection end points can be configured.
S5 station	For S5 stations in the subnet	-
Other station	For devices made by other manufacturers which are connected to the subnet.	-

* SIMATIC NET products on CD up to 10/98

** SIMATIC NET Products on CD as from 10/98, see also Product Information re. this CD or S7-REDCONNECT

Procedure

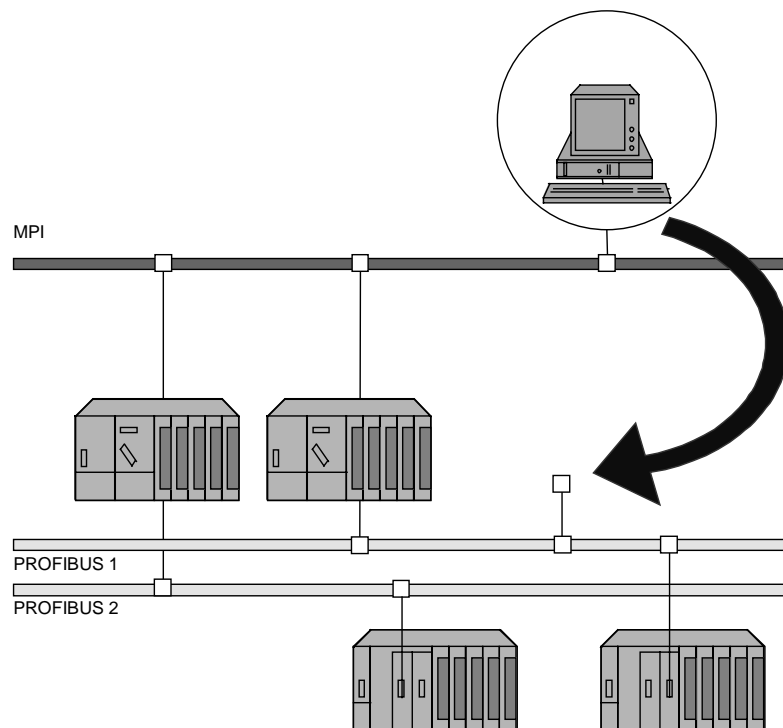
1. If the "Catalog" window is not visible:
Open the "Catalog" window using the menu command **View > Catalog**.
2. In the "Catalog" window click on the required object (under "Stations"), hold the mouse button pressed, and use the drag & drop function to copy it to the window for the graphic network view.
Invalid positions in the view window are shown by a  sign instead of the cursor.
Alternatively you can also double-click the required object in the "Catalog" window.
3. Double-click the object.
Result: A dialog box with tabs for setting the properties is displayed.
4. Set the properties:
 - For all objects apart from SIMATIC PC stations: in the "Interfaces" tab, create the type of interface that the real object has (for example, PROFIBUS). Via the "Properties" button, set the node and subnet properties.
Result: The object receives an interface symbol for every newly created interface.
 - For the "PG/PC" object: In the "Assignment" tab, set an assignment to an existing module parameter assignment (PC card) if necessary. With this assignment you link the "PG/PC" object in the network view with the actual module parameters of your PG/PC. Advantage: If you, for example, change the transmission rate of the subnet, the module parameters for your PG/PC card[0] change automatically.

8.7 Taking Connections for Programming Devices/PCs into Account in the Network Configuration

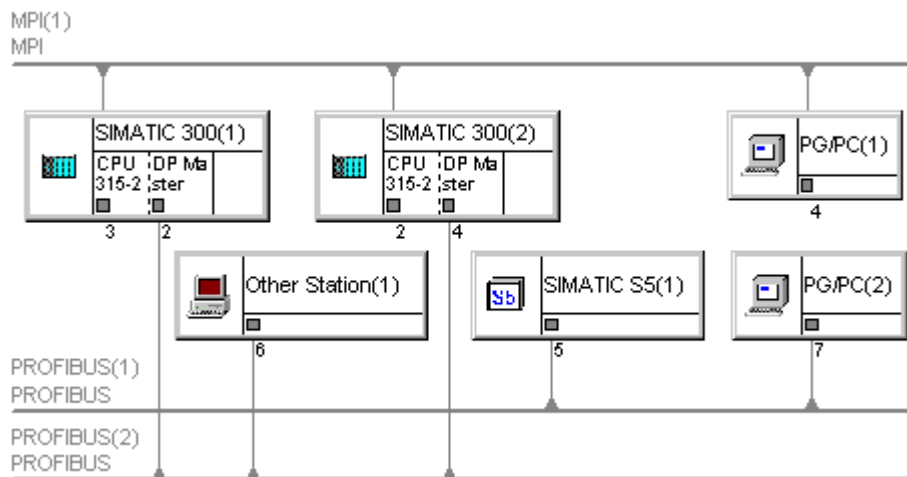
If you have a networked project with a number of different subnets, you can set up a number of wildcards in the network configuration for a PG(PC) you want to connect up later on. The "PG/PC" object in the network view assumes this "wildcard" function.

This allows you to disconnect a programming device from a subnet and connect it to another subnet. You tell STEP 7 about the PG relocation when you use the **"PLC > Assign PG/PC"** menu command.

The figure below illustrates the setup:



The connection points in the network view look like this ("PG/PC(1)" and "PG/PC(2)"):



You can now assign your PG one of the "PG/PC" symbols (to identify the device you intend to use for accessing stations online). Assignment updates the interfaces in the programming device (PG or PC) to match the configured settings. If you change your configured settings (e.g. by modifying the transmission rate or another network property), the interface in your PG or PC will be updated automatically.

Procedure

1. If the PG/PC has already been assigned: Reverse the assignment by selecting the "PG/PC" symbol and activating the **PLC > Remove PG/PC Assignment** menu command. The assigned PG/PC symbol differs from the symbol for non-assigned PGs/PCs.
2. Select a "PG/PC" symbol in the network view to represent the programming device you have connected.
3. Select the **PLC > Assign PG/PC** menu command.
4. Use the "Assignment" tab to assign a set of interface parameters in your programming device (your PG/PC) to an interface of the "PG/PC" symbol.

8.8 Creating and Assigning Parameters to SIMATIC PC Stations

Introduction

The SIMATIC PC station (referred to here simply as "PC station") represents a PC or an operator station whose application (such as WinCC) is the end point of a connection.

Comparison: S7 Station – PC Station

The structure of S7 stations is represented by the "Hardware" object in the SIMATIC Manager; by double-clicking "Hardware" you start the application for configuring the S7 station. The end points of a connection are modules that are inserted in the real station. The interfaces to subnets are formed by configurable CPUs, CPs, or interface submodules.

The structure of PC stations is represented by the "Configuration" object in the SIMATIC Manager; by double-clicking "Configuration" you open the dialog box for configuring the PC station. The end points of a connection are applications that are installed in the real PC (OS). The interfaces to subnets are formed by configurable PC communication cards.

Procedure

1. Start NetPro.
2. Insert the "SIMATIC PC Station" object from the "Catalog" window in your network configuration.
3. Double-click the "SIMATIC PC Station" object.
4. Select the "Configuration" tab.
5. The name "Application" is selected under "PC Applications."
6. Click the "Properties" button.
7. Change the name of the application in the next dialog box so that it matches the name on the programmable control system and confirm your choice with "OK."
8. If other applications are installed on the programmable control system which are the end point of a connection, extend the list of PC applications using the "Add" button.
9. Click the "Add" button under "PC Communication Cards."
10. Select the communication card that is installed on your PC station (programmable control system). This sets the interface between the SIMATIC PC station and a subnet.
11. Select the "Properties" button and set the properties for the communication card.
12. Extend the list of communication cards using the "Add" button.

13. Correct the storage location of the XDB file if necessary.
14. Configure the entire network in NetPro with the connections to and from the PC station
15. Select the menu command **Network > Save and Compile**.
16. During compilation, an XDB file is created for the PC station which contains the names of the PC station, connection descriptions, and parameter and subnet information for the PC communication cards.
17. Install the XDB file on the PC station (programmable control system).

Configuring Connections for a SIMATIC PC Station

8.9 Saving and Downloading Configurations and Executing a Consistency Check

8.9.1 Checking the Consistency of the Network

Before you save, you should check the network configuration for consistency. The following are reported, for example:

- Nodes that are not connected to a subnet (exception: non-networked MPI nodes)
- Subnets that have only one node
- Inconsistent connections

Requirement

NetPro must be open.

Procedure

- Select the menu command **Network > Consistency Check**.
Result: A window with hints for configuring conflict-free networks and connections is displayed.

Tip

You can select the window containing the results of the last consistency check at any time using the menu command **View > Errors and Warnings**.

Alternative Procedure

1. Select the menu command **Network > Save and Compile**.
2. In the dialog box, select the option "Check and compile all."

8.9.2 Downloading the Network Configuration for the First Time

Before you download for the first time, the modules connected to the subnet do not yet have their configured node address, but a default address. In order that your network functions correctly, each node in a subnet must have a different node address.

- **MPI subnet with connection via the CPU**
CPUs are supplied with the default address 2. However, you can only use this address once in a subnet, so you will have to change the default node address for any other CPUs.
- **PROFIBUS and Industrial Ethernet subnets with CPs**
The CPs of the stations that are run via these subnets must be configured and assigned a node address. You should always assign the address via the MPI of the station before you can download and communicate via the subnet (you will find more information in the SIMATIC NET, NCM S7 for PROFIBUS, and NCM for Industrial Ethernet manuals).

If the Network Node is Not an S7 Station...

If the network node is not an S7 station, the network and node properties must be assigned using the tool or switches intended for this purpose. This is the case for DP slaves, for example, whose PROFIBUS address must be set using switches.

Ensure that these settings match the settings for the objects in the network view (PG/PC, Other Station, S5 Station).

Changing the PROFIBUS Address of DP Slaves

DP slaves connected to a PROFIBUS subnet must also have a unique PROFIBUS address. If the DP slave you want to connect supports the function "Set_Slave_Add" (for example, ET 200C), you can assign the address with STEP 7:

In the SIMATIC Manager and in Configuring Hardware you can assign a new PROFIBUS address using the menu command **PLC > Assign PROFIBUS Address**.

Tip: If you are not entirely certain of the current address assignment, you should connect the DP slaves to the PG/PC one by one and re-address them.

Changing the Node Address of S7 Stations

To change the preset node address, proceed as follows for S7 stations:

1. Configure the station; set the node address of the connected module (for example, a CPU) in the "General" tab ("Properties" button under "Interface").
2. Switch the module to STOP and connect your programming device to the interface on the module via a connecting cable.
3. Determine the preset node address of the connected module (using, for example, the menu command **PLC > Display Accessible Nodes** in the SIMATIC Manager).
4. Download the configuration with the new node address to the programmable controller (that is, to the connected module):
 - In the station view (Configuring Hardware) using the menu command **PLC > Download**
 - In the network view (NetPro) select the station you want to download and select the menu command **PLC > Download > Selected Stations**. Enter the "old" (still valid) preset address.

8.9.3 Downloading Changes to the Network Configuration

Requirements

All networked modules in a subnet must have unique node addresses and the actual configuration must match the network configuration you created.

If you connect a new station to a subnet and the preset node address is already present in the subnet, you should proceed as described under "Downloading for the First Time."

What is Downloaded Where?

After compiling the network configuration (menu command **Network > Save and Compile**) or after **PLC > Download > ...** NetPro creates system data blocks (SDBs) for modules that can interpret the information in the SDBs. The SDBs can contain connection tables, node addresses, subnet properties, input/output addresses, and module parameters.

Depending on which menu command you choose for downloading, different contents are downloaded to different programmable control systems.

Note

Only with the option **PLC > Download > Connections and Network Gateways** can you download with the participating CPUs in RUN-P mode. For all other options the CPU must be switched to STOP.

Menu Command PLC > Download >	What is Downloaded?	Where?
... Selected Station(s)	Connection tables, node addresses, subnet properties, input/output addresses, and module parameters for the selected stations	To the selected stations
... Selected and Partner Stations	Connection tables, node addresses, subnet properties, input/output addresses, and module parameters for the selected station and the connection partners of the selected station	To the selected station and to all stations that are connection partners of this station
... Stations on Subnet	Connection tables, node addresses, subnet properties, input/output addresses, and module parameters	One after another to all stations on the selected subnet
... Selected Connections	Selected connections (multiple selections possible)	To the local station and (for two-way connections) to the corresponding partner stations
... Connections and Network Gateways	Connections (an empty connection table is also possible) and network gateway information	To the selected module and the partner stations (possible in RUN-P mode)

Procedure

1. Connect the programming device to the subnet to which the node you want to load is connected.
2. Open NetPro.
3. Select the station you want to download or the subnet (for **PLC > Download > Stations on Subnet**) in the network view.
4. Select one of the above options for the menu command **PLC > Download**.

8.9.4 Uploading a Network Configuration

Overview

You have the possibility of uploading the real network structure of your project station by station to your programming device.

Firstly you can upload the whole configuration for a project station by station to the programming device in the SIMATIC Manager (menu command **PLC > Upload**). STEP 7 then creates a new station object in the current project for each station you want to upload.

Alternatively you can upload a station configuration when you configure the hardware (menu command **PLC > Upload**).

Below is a description of how you can upload the whole network configuration station by station in NetPro.

Requirements

The PG/PC is connected to the same subnet as the stations you want to upload or the stations are accessible via network gateways. The node addresses and racks/slots of the modules connected to the subnet are known.

Procedure

1. Connect the programming device to the subnet to which the node you want to load is connected.
2. Create a new project for the loaded network configuration if necessary.
3. Open NetPro via a project to which you want to save the uploaded network configuration at a later stage (for example, via a newly created project).
4. Select the menu command **PLC > Upload Station**.
The menu command can be selected only when a project is open.
5. In the following dialog box, specify the station to be uploaded by giving its node address and rack/slot.
The "Station" object appears in the network view with all modules that have a network connection. The subnets to which the station is connected are also displayed. You can change the name of the station assigned by the system using the menu command **Edit > Object Properties**.
The configured connections are also uploaded and are visible when you select a module that is the end point of connections.
6. You can modify the station configuration or the connections as well and then load the changes into the station. For connections that were created using optional packages, the optional package must be installed so that these connections can be edited and loaded into the station again.
7. Proceed as described above until you have loaded all the required stations.
8. If required, you can save the network configuration in the current project (menu command **Network > Save** or **Network > Save and Compile**).

Special Features of Connections Uploaded to the Programming Device

In the connection table, the connection partner configured offline is missing – the connection partner is "unspecified." However, address details are available in the dialog box that follows the properties dialog box.

The communication direction of PTP connections cannot be determined by STEP 7 in every case; but a message informs you of which communication directions are likely.

8.9.5 Tips for Editing the Network Configuration

Starting Global Data Configuration

1. Select an MPI subnet in the network view for which you want to configure global data communication.
2. Select the menu command **Options > Define Global Data**.

Result: The GD table for the MPI subnet is opened.

Configuring Connections

If you select a component in the network view that can be an end point of a connection (for example, a CPU), the connection table in which you can configure connections is displayed automatically.

Highlighting the Communication Partners of a Module

If you have already configured connections:

1. Select a programmable module (CPU, FM) in the network view.
2. Select the menu command **View > Highlight > Connections**.

Note: The communication partners of only one programmable module can be highlighted at any one time.

Displaying/Changing the Properties of Components

To display or change the properties of stations or module, proceed as follows:

1. Select the component (station symbol or module).
2. Select the menu command **Edit > Object Properties**.

Copying Subnets and Stations

1. Select the network objects you want to copy by clicking them with the left mouse button. If you want to copy more than one network object at the same time, select additional network objects with SHIFT + left mouse button.
2. Select the menu command **Edit > Copy**.
3. Click the position in the network view where you want to place the copy and select the menu command **Edit > Paste**.


Note: You can copy individual network objects or whole subnets with network connections, stations, and DP slaves. When copying, remember that every node in a subnet must have a unique node address. You should therefore change the node address if necessary.

Deleting Network Connections, Stations, and Subnets

1. Select the symbol for the network connection, the station, the DP slave, or the subnet.
2. Select the menu command **Edit > Delete**.
When you delete a subnet, the stations which were previously connected to the subnet are retained and can be connected to another subnet if required.

Positioning Stations and Subnets

You can move subnets, stations, and DP slaves (with or without a network connection) anywhere in the view window. This means you can replicate your hardware structure visually on the screen.

- Click the subnet or station/DP slave, hold the mouse button pressed, and use the drag & drop function to move the subnet or station/DP slave to the required position.
Invalid positions for subnets or stations/DP slaves in the view window are shown by a  sign instead of the cursor.

You can also move stations/DP slaves that are already connected to a subnet. The network connections of the stations/DP slaves are retained.

Selecting a DP Master System

You can select a whole master system to copy it, for example.

1. Select a DP master or a DP slave in the network view.
2. Select the menu command **Edit > Select > Master System**.

Highlighting a DP Master System

1. Select a DP master or a DP slave in the network view.
2. Select the menu command **View > Highlight > Master System**.

Online Access to Modules

You have access to the following functions via the PLC menu:

- Display module information
- Change the operating mode of a module
- Clear/reset a module
- Set the date and time for a module
- Download and upload

8.9.6 Downloading the Network Configuration to a Programmable Controller

Requirement

Here we shall assume that the entire project was already configured, meaning you have:

- Configured all stations
- Created all subnets and set their properties
- Configured connections (if required)
- Set the PG/PC interface so that communication between the PG/PC and the programmable controller is possible via the connected subnet.
- Checked the configuration for consistency

Only when a configuration is free of errors, meaning when all networked modules in a subnet have unique node addresses and when their actual configuration matches the network configuration you have created should you download the configuration via the subnet (PROFIBUS or MPI) to the programmable controllers.

8.9.7 Saving the Network Configuration

Introduction

To save the connection table, you can choose either of the menu commands **Network > Save** and **Network > Save and Compile**.

Saving

If you have created the network objects in NetPro or changed their properties in NetPro, NetPro saves the following using the menu command **Network > Save**:

- Node addresses
- Subnet properties (such as transmission rate)
- Connections
- Modified module parameters (for example, of CPUs)

Saving and Compiling

When you select the menu command **Network > Save and Compile** you must specify in a dialog box whether you want to compile everything or just the changes:

Independent of the selected option, NetPro checks the consistency of the configuration data throughout the project; any messages are displayed in a separate window.

- "Check and compile all" option
The loadable system data blocks (SDBs) for the entire network configuration are created; they contain all connections, node addresses, subnet properties, input/output addresses, and module parameters.
- "Compile changes only" option
Loadable system data blocks (SDBs) for **modified** connections, node addresses, subnet properties, input/output addresses, and module parameters are created.

9 Configuring Connections

9.1 Introduction to Configuring Connections

Introduction

Communication connections are always required when you want to exchange data using special communication blocks (SFBs, FBs, or FCs) in the user program.

This section describes how you define connections with *STEP 7*, which particular features you should note, and which communication blocks you can use in the user program.

What is a Connection?

A connection is a logical assignment of two communication partners to execute communications. A connection determines the following:

- The partners involved in communication
- The type of connection (for example, S7, point-to-point, FDL, or ISO transport link)
- Special properties (such as whether a connection remains permanently configured, or whether it is established and disconnected dynamically in the user program, and whether operating mode messages should be sent).

What Happens When You Configure Connections?

When you configure connections, a unique "local ID" is assigned for each connection. Only this local ID is required when you assign parameters to communication blocks. Every programmable module that can be an end point in a connection has its own connection table.

9.2 What You Should Know About the Different Connection Types

Introduction

The following sections provide a brief overview of the connection types you can configure with STEP 7. The "Communicating with SIMATIC" manual provides a more detailed description of the communications possibilities in SIMATIC.

S7 Connections

S7 connections include the following features:

- Can be configured in all S7/M7 devices
- Can be used in all types of subnet (MPI, PROFIBUS, Industrial Ethernet)
- When using the SFBs BSEND/BRCV: secure transfer of data between SIMATIC S7/M7-400 stations; for example, exchanging data block contents (up to 64 Kbytes)
- When using the SFBs USEND/URCV: fast, unsecured transfer of data independent of the time processing of the communication partner; for example, for event messages and messages.
- Acknowledgement of data transfer from the communication partner via layer 7 of the ISO reference model

S7 Connections, Redundant

- Properties as for S7 connections; however, restricted to S7 H CPUs and not on MPI subnets
- Depending on the network topology, at least two connection paths between the connection end points are possible with a redundant S7 connection

Point-to-Point Connection

The local CP 441 provides the link for the connection between an S7-400 CPU and a communication partner connected via a point-to-point connection. On the CP, a conversion is made to the addressing mechanisms of the selected transfer procedure. For this reason, the point-to-point connection ends in the CP 441 and not at the communication partner as for other connection types.

The number of connections to the CP depends on the set procedure.

FMS Connection

PROFIBUS FMS (Fieldbus Message Specification) has the following features:

- For the transfer of structured data (FMS variables)
- Fulfills the European standard EN 50170 Vol.2 PROFIBUS
- For open communication with non-Siemens devices on PROFIBUS
- Application on the remote communication partner acknowledges receipt of the data
- Can be ordered in layer 7 of the ISO reference model
- FMS services are provided on the PC as C functions

FDL Connection

PROFIBUS FDL (Fieldbus Data Link) has the following features:

- For the transfer of data to a communication partner (for example, SIMATIC S5 or PC) that supports sending and receiving in accordance with the SDA function (Send Data with Acknowledge)
- The receipt of data is confirmed by the FDL service of the communication partner with an acknowledgement
- For PROFIBUS subnets only
- Fulfills the European standard EN 50170 Vol.2 PROFIBUS
- Can be ordered in layer 2 of the ISO reference model
- FDL services are provided on the PC as C functions

ISO Transport Connection

The ISO Transport connection has the following features:

- Suitable for large quantities of data owing to "data blocking"
- Allows communication to a partner (for example, SIMATIC S5 or PC) that supports sending and receiving of data in accordance with ISO Transport
- For Industrial Ethernet only
- The receipt of data is confirmed by the ISO Transport service of the communication partner with an acknowledgement
- ISO Transport (ISO 8073 class 4) corresponds to layer 4 of the ISO reference model
- ISO Transport services are provided on the PC as C functions

ISO-on-TCP Connection

The ISO-on-TCP connection has the following features:

- Fulfills the TCP/IP (Transmission Control Protocol/Internet Protocol) standard with the extension RFC 1006 in accordance with layer 4 of the ISO reference model. RFC 1006 describes how the services of ISO layer 4 can be mapped onto TCP
- Allows communication to a partner (for example, SIMATIC S5 or PC) that supports sending and receiving of data in accordance with ISO-on-TCP
- The receipt of data is confirmed with an acknowledgement
- For Industrial Ethernet only
- ISO-on-TCP services are provided on the PC as C functions

UDP Connection

The UDP (User Datagram Protocol) connection has the following features:

- For Industrial Ethernet (TCP/IP protocol)
- Allows unsecured transfer of contiguous blocks of data between two nodes

E-Mail Connection

The e-mail connection has the following features:

- For Industrial Ethernet (TCP/IP protocol)
- Enables process data, for example, to be sent from data blocks via e-mail using an IT communications processor
- Using the e-mail connection, you define the mail server via which all e-mails sent by an IT communications processor are delivered.

9.3 Blocks for Different Connection Types

Blocks for Use with S7 Connections

SFB		Brief Description
SFB8	USEND	Uncoordinated data exchange using a send and a receive SFB
SFB9	URCV	
SFB12	BSEND	Exchange blocks of data of variable length between a send SFB and a receive SFB
SFB13	BRCV	
SFB14	GET	Read data from a remote device
SFB15	PUT	Write data to a remote device
SFB19	START	Execute a warm restart on a remote device
SFB20	STOP	Switch a remote device to STOP mode
SFB21	RESUME	Execute a hot restart in a remote device
SFB22	STATUS	Specific query of the status of a remote device
SFB23	USTATUS	Receive status messages from remote devices

Blocks for Use with Point-to-Point Connections

For the point-to-point connection type you can use the SFBs BSEND, BRCV, GET, PUT, and STATUS (see above table).

You can also use the SFB PRINT:

SFB		Brief Description
SFB16	PRINT	Send data to a printer

Blocks for Use with FMS Connections

FB	Brief Description
READ	Read variables from a remote device
WRITE	Write variables to a remote device
IDENTIFY	Identify the remote device for the user
ACCESS	Allows write and read accesses to be coordinated (disable, enable, consistent transfer)
OSTATUS	Provide the status of a remote device on request from the user
REPORT	Report variables to the remote device

Blocks for Use with FDL, ISO-on-TCP, and ISO Transport Connections

FC	Brief Description
AG-SEND	Send data via a configured connection to the communication partner
AG-RECV	Receive data via a configured connection from the communication partner

9.4 Configuring Connections to Partners in the Same Project

9.4.1 Connection Types and Connection Partners in the Same Project

Selecting the Connection Type for Connection Partners in the Same Project

The connection type is dependent on the subnet and the transfer protocol via which the connection is established, and on the automation family to which the connection partners belong.

Which blocks (SFBs, FBs, or FCs) you can use depends on the connection type.

The following table should make it easier for you to select the connection type for the connection you want to establish.

Connection Type	Subnet Type	Connection between SIMATIC...	SFB/FB/FC
S7 connection	MPI, PROFIBUS, Industrial Ethernet	S7 – S7, S7 – PG/PC, S7 – PG/PC with WinCC with MPI also: M7 – M7, M7 – S7, M7 – PG/PC S7 – partner in another project (S7, PG/PC with WinCC)	SFBs USEND, URCV, BSEND, BRCV, GET, PUT, START, STOP, RESUME, STATUS, USTATUS
S7 connection, fault-tolerant	PROFIBUS, Industrial Ethernet	S7(H) – S7(H), S7(H) – PC station (H)	SFBs USEND, URCV, BSEND, BRCV, START, STOP, RESUME, STATUS, USTATUS
PTP connection	Point-to-point (computer protocol RK 512/3964(R))	S7 – S7, S7 – S5, S7 – non-Siemens device S7 – partner in another project (S7, non-Siemens device)	SFBs BSEND, BRCV, GET, PUT, STATUS, PRINT
FMS connection	PROFIBUS (FMS protocol)	S7 – S7, S7 – S5, S7 – PG/PC, S7 – non-Siemens device, S7 – broadcast to all nodes S7 – partner in another project (S7, S5, PG/PC, non-Siemens device)	FBs READ, WRITE, IDENTIFY, OSTATUS, REPORT
FDL connection	PROFIBUS (FDL protocol)	S7 – S7, S7 – S5, S7 – PG/PC, S7 – non-Siemens device S7 – partner in another project (S7, S5, PG/PC,	FCs AG-SEND, AG-RECEIVE

Connection Type	Subnet Type	Connection between SIMATIC...	SFB/FB/FC
		non-Siemens device)	
ISO transport link	Industrial Ethernet (ISO Transport protocol)	S7 – S7, S7 – S5, S7 – PG/PC, S7 – non-Siemens device, S7 – unspecified S7 – partner in another project (S7, S5, PG/PC, non-Siemens device, unspecified)	FCs AG-SEND, AG-RECEIVE
ISO-on-TCP connection	Industrial Ethernet (TCP/IP protocol)	S7 – S7, S7 – S5, S7 – PG/PC, S7 – non-Siemens device, S7 – unspecified S7 – partner in another project (S7, S5, PG/PC, non-Siemens device, unspecified)	FCs AG-SEND, AG-RECEIVE
UDP connection	Industrial Ethernet (TCP/IP protocol)	S7 – S7, S7 – S5, S7 – PG/PC, S7 – non-Siemens device, S7 – unspecified S7 – partner in another project (S7, S5, PG/PC, non-Siemens device, unspecified)	FCs AG-SEND, AG-RECEIVE
E-mail connection	Industrial Ethernet (TCP/IP protocol)	S7 – unspecified (S7 – mail server)	FCs AG-SEND, AG-RECEIVE

Special Feature: Connection to Broadcast and Multicast Nodes

For special connection types there is the option of selecting not just one connection partner, but several (broadcast and multicast nodes). These options are described in the SIMATIC NET (NCM S7) manuals. The connection partners "all broadcast nodes" or "all multicast nodes" are listed in the dialog box for entering a new connection.

- You can set up a connection to "all broadcast nodes" (simultaneous sending to all broadcast receivers) for the connection types FMS, FDL, and UDP connection.
- You can set up a connection to "all multicast nodes" (simultaneous sending to several nodes) for the connection type FDL connection.

9.4.2 Rules for Creating Connections

Selecting a Connection Path With More Than One Subnet

If stations are connected to a number of subnets, STEP 7 chooses a connection path via one of the subnets. This connection path was found by STEP 7 to be more efficient than the others. STEP 7 selects a preferred subnet in the following order: Industrial Ethernet before Industrial Ethernet/TCP/IP before MPI before PROFIBUS.

Example: Two stations are networked together via MPI and Industrial Ethernet. STEP 7 chooses the route via Industrial Ethernet.

Note that the route selected by STEP 7 remains even if the connection to the subnet is lost. STEP 7 does not select an alternative route via another subnet (exception: redundant S7 connections).

In an S7 connection, the connection path set automatically by STEP 7 can be changed by the user in the properties dialog box for the connection, for example, from MPI to PROFIBUS.

Number of Possible Connections

The number of possible connections which can be entered in the connection table depends on the resources of the selected module and is monitored by STEP 7.

9.4.3 Configuring Connections for Modules in a SIMATIC Station

9.4.3.1 Configuring Connections for Modules in a SIMATIC Station

The following section shows you how to create connections for a connection end point (for example, a CPU) in the network view.

9.4.3.2 Entering a New Connection

A connection defines the communication relationship between two nodes. It defines the following:

- The two communication nodes involved
- The connection type (for example, S7, point-to-point, FMS, ISO-on-TCP, FDL, or ISO Transport)
- Special properties which depend on the type of connection (such as whether a connection remains permanently configured, or whether it is set up/broken dynamically in the user program)

Requirement

You must be in the network view of NetPro.

Procedure

1. In the network view, select the module for which you want to create a connection.
Result: The connection table for the selected module is displayed in the lower half of the network view.
2. Double-click an empty row in the connection table, or select a row and select the menu command **Insert > Connection**.
3. In the "New Connection" dialog box select the required connection partner. You can obtain help with selecting a connection partner in the online help for this dialog box.
4. Specify the type of connection.
5. Activate the "Show Properties dialog box" check box if you want to view or change the properties for the connection after clicking "OK" or "Add:"
The contents of the "Properties" dialog box is dependent on the connection selected; you can obtain help with filling it out in the online help for the dialog box.
Result: STEP 7 enters the connection in the connection table of the local (selected) node and assigns the local ID and a partner ID if required for this connection which you will need when programming the communication function blocks (value for the block parameter "ID").

9.4.3.3 Changing the Connection Partner

You can change the connection partner for a previously configured connection. The local ID and the connection type are retained.

Requirement

You must be in the network view of NetPro.

Procedure

1. In the network view, select the module for which you want to modify a connection.
2. Select the row in the connection table containing the connection you want to modify.
3. Double-click the selected area of the "Partner" column or select the menu command **Edit > Connection Partner**.
Result: The "Modify Connection" dialog box appears.
4. In the "Station" and "Module" boxes, select the programmable module to which the connection should now be made.
5. Activate the "Show Properties dialog box" check box if you want to view or change the properties for the connection after clicking "OK" or "Add."
6. Confirm your entries by clicking "OK."
Result: STEP 7 updates the connection in the connection table of the local node. If a local ID and a partner ID for the connection were entered in the connection table, STEP 7 deletes the connection from the connection table of the old partner.

Notes:

Note that the configured properties of the connection will be returned to the default setting when the connection partner is modified. Use the menu command **Edit > Object Properties** if you wish to change the properties of the connection.

The following applies to S7 connections: You can change an "unspecified" connection partner from STEP 7 V5 onwards (for example, to a SIMATIC 300/400 station). You can also change the SIMATIC station partner to "unspecified."

9.4.3.4 Reserving a Connection

If you wish to reserve the communication resources of a node to expand your project at a later date, or if you do not wish to specify a connection partner yet, you can enter "Unspecified" for the connection partner. Reserving connections is currently not possible for all connection types.

Requirement

You must be in the network view of NetPro. The properties dialog box for the connection is open.

Procedure

1. In the "Station" box, select the option "Unspecified."
Result: The entry in the "Module" box is deactivated.
2. Select the connection type in the "Type" box.
3. Activate the "Show Properties dialog box" check box if you want to view or change the properties for the connection after clicking "OK" or "Add."
4. Confirm your entries by clicking "OK."
Result: STEP 7 enters the connection in the connection table of the local node and assigns the local ID for this connection which you will require for programming the communication blocks.

Note

Note that you can also assign special properties for each connection. To do this, select the menu command **Edit > Object Properties**.

9.4.3.5 Deleting One or More Connections

Requirement:

You must be in the network view of NetPro.

Procedure

1. Select the connections you wish to delete.
2. Select the menu command **Edit > Delete**.
If local ID and partner ID for the connection were entered in the connection table, STEP 7 also deletes the connection in the table for the connection partner.
3. Download the connection tables with the deleted connections to the relevant programmable module. (To delete all the connections of a programmable module, you must download an empty connection table to the module.)

9.4.3.6 Copying Connections

Introduction

Connections are not copied individually but always in context with the project or the station.

You can copy the following:

- Entire projects
- One or more stations within a project or beyond the boundaries of a project

Requirement

The SIMATIC Manager must be open.

Copying a Project

When you copy a project, all configured connections are also copied. There are no settings required for the copied connections because the connections remain consistent.

Copying a Station

When you copy one or more stations, you must reassign the connection partners to each local node (modifying a connection).

If no connection partner exists for a connection, you will see this in the connection table, since the row of the connection partner will be displayed in bold.

9.4.4 Configuring Connections for a SIMATIC PC Station

9.4.4.1 Configuring Connections for Modules in a SIMATIC Station

You can configure S7 connections and fault-tolerant S7 connections for SIMATIC PC stations. If you want to create or modify fault-tolerant S7 connections, you must make sure you have installed the corresponding optional package.

Requirements

You have configured a SIMATIC PC station in the network view with all the communication end points ("applications") and PC communication cards. You have also configured all the stations that are the communication end points of the connections.

How to Configure a Connection

1. Select the "application" of the SIMATIC PC station in the network view, so that the connection table is visible.
2. Double-click an empty row in the connection table or highlight a row and select the menu command **Insert > Connection**.
3. Select the required connection partner in the "New Connection" dialog box. You can find help on selecting the connection partner in the online help for this dialog box.
4. Define the type of connection.
Special property of the connection: In contrast to S7 stations, STEP 7 assigns a name instead of a numerical value for the local ID (connection ID). You can change this name in the object properties of the connection.
New connections are always two-way connections; that is, STEP 7 automatically enters a connection to the local station in the connection table of the partner.
5. Select the menu command **Network > Save and Compile**.
6. On compilation, a configuration file ("XDB file") is generated for the PC station. This contains the name of the PC station, the connection descriptions, and the assigned parameters and subnet information for the PC communication cards.
7. Install the configuration file on the PC station (programmable logic controller).

9.4.5 PG/PC as Connection Partner

9.4.5.1 Programming Devices / PCs as Connection Partners

When configuring connections for an end point on a programming device or PC, you have various options. Select either the "PG/PC" object or the "SIMATIC PC Station" object in the network view:

- PG/PC for an SAPI-S7 interface
- SIMATIC PC station, for example, for programming devices or PCs with the optional package S7-REDCONNECT (fail-safe S7 communication).

9.4.5.2 S7 Connection to a PG/PC with an SAPI-S7 Interface

An S7 connection from an S7 station to a PG/PC is only possible if the PG/PC has an SAPI-S7 programming interface (C programming interface for access to SIMATIC S7 components).

You will find more information on filling out the dialog box in the online help for this dialog.

For the Connection Partner "PG/PC"

One method of configuring connections is by creating an LDB (local database):

1. Configure the PG/PC in the network view.
2. Configure the station from which a connection should go to the PG/PC.
3. When you create the S7 connection you must select "PG/PC" as the connection partner.
4. Edit the "Address Details" dialog box (accessible via the properties of the connection). In this dialog box you enter the name of the connection and the virtual field device name of the programming device/PC. You will find more information in the online help for this dialog box.
5. Then double-click the configured programming device/PC and generate the local database (LDB).
6. Transfer the database to the programming device/PC.
7. Download the connection(s) to the station.

For the Connection Partner "SIMATIC PC Station"

For the programming device/PC you create a SIMATIC PC station in the network view. The SAPI-S7 programming interface forms the end point of a connection with this station type.

9.4.5.3 S7 Connection to a PG/PC with WinCC

For the Connection Partner "Unspecified"

You can create S7 connections to PGs/PCs with *WinCC* within a project or beyond project boundaries. When you create the S7 connection you must select "Unspecified" as the connection. You enter special address information for *WinCC* in the "Address Details" dialog box.

For the Connection Partner "SIMATIC PC Station"

For the programming device/PC you create a SIMATIC PC station in the network view. WinCC forms the end point of a connection with this station type.

9.5 Configuring Connections to Partners in Other Projects

9.5.1 Connection Types and Connection Partners in Other Projects

Overview

To make the correct choice of which connection to configure it is important to know which partner is to be addressed in the other project. The connection type and the connection partner you select when you configure the connection is dependent on this.

Connection Type	Partner in Other Project Can Be...	Configure Connection to Connection Partner...
S7 connection	PG/PC with <i>WinCC</i> (software that turns a programming device/PC into an operator station (OS)), S7 CPU/FM, WinAC FI station PRO	"Unspecified"
PTP connection	S7 station with PTP CP, non-Siemens device (for example, bar code reader, printer)	"Unspecified"
FMS connection, FDL connection	S7 station, S5 station, PG/PC, non-Siemens device	"Unspecified" or "other station" (for S7 station or non-Siemens device), "S5 station," or "PG/PC" created in the SIMATIC Manager
ISO Transport connection, ISO-on-TCP connection	S7 station, S5 station, PG/PC, non-Siemens device	"Unspecified" or "other station" (for S7 station or non-Siemens device), "S5 station," or "PG/PC" created in the SIMATIC Manager

Special Cases for PTP Connections

In contrast to the S7 connections, for configuring PTP connections to unspecified partners it is not a requirement that the local node is in a network. You must simply make sure you connect the communication partners in your real plant before you attempt to use the connection.

9.5.2 Basic Procedure

Possible Connection Partners in the Other Project

There are two methods of setting up connections to connection partners in other STEP 7 projects:

- Set up a connection to an "other station," a "PG/PC," or a "SIMATIC S5 station"
- Set up a connection to an "unspecified" connection partner

Note:

Connections to "other stations," "SIMATIC S5 stations," "PG/PC," and "unspecified" connection partners are also possible within a STEP 7 project. To which of these connection partners connections can be set up depends, among other things, on the connection type.

Differences Between the Two Methods

You must configure an "other station", a "PG/PC", or a "SIMATIC S5 station" as subnet nodes in the current STEP 7 project. **Restriction:** For "other stations" and SIMATIC S5 stations you cannot configure S7 connections. All other connection types are possible.

No subnet node needs to be configured in the current STEP 7 project for an unspecified partner. You can set up S7 connections, PTP connections, ISO Transport connections, and ISO-on-TCP connections to unspecified connection partners.

9.5.3 Creating a New Connection to an Unspecified Partner

FMS, FDL, ISO-Transport, and ISO-on-TCP Connections

FMS, FDL, ISO-Transport, and ISO-on-TCP connections are described in the SIMATIC NET, NCM for PROFIBUS, and NCM for Industrial Ethernet manuals.

Requirement

You must be in the connection table view (NetPro).

Procedure

You create an S7 or point-to-point connection to an "unspecified" connection partner as follows:

1. Select a module from which you want to run the connection (local node).
2. Double-click an empty row in the connection table, or select a row and select the menu command **Insert > Connection**.
3. In the "New Connection" dialog box select "Unspecified" as the connection partner.
4. Set the properties for the connection:
 - For PTP connections: in the properties dialog box for the PTP connection change the name of the partner from "unspecified" to a suitable name (the name is also entered in the connection table).
 - For S7 connections: click the "Address Details" button in the properties dialog box.
 - Depending on the connection partner, different settings are necessary in the "Address Details" dialog box. You will find more information on filling out the dialog box in the online help.

9.5.4 Creating a Connection to an "Other Station," a "PG/PC," or a "SIMATIC S5 Station"

Requirement

You must have created the entire network configuration in both projects.

Stations that were configured in one project must be entered in the other project as an "other station."

The network view (NetPro) must be open.

Procedure

The procedure is the same as for creating connections to a partner (PG/PC, "other station," and SIMATIC S5) within one project.

9.6 Saving Connections

9.6.1 Saving Connections

NetPro saves connections (menu command **Network > Save**) implicitly with all network and station data that are relevant for a functioning network configuration.

10 Configuring Global Data Communication

10.1 Overview: Global Data Communication

Introduction

Global data communication (GD communication) is a simple method of communication integrated in the operating system of the S7-300 and S7-400 CPUs.

GD communication allows the cyclic exchange of data between CPUs via the multipoint interface. Cyclic data exchange takes place with the normal process image.

Global data communication is configured with STEP 7; transferring global data is done by the system and is not therefore programmed.

The following sections show how you can estimate using the technical specifications as given for every CPU (number of GD circles, size and number of GD packets etc.) what quantities of data can be exchanged between CPUs using the "GD communication" process.

The following are also listed:

- Send and receive conditions to be observed
- The formula for estimating the approximate response time

What Are Global Data?

Global data as they are used in the GD communication process are the following address areas in the CPU:

- Inputs, outputs (from the process image)
- Bit memory
- Data block areas
- Timers, counters (not recommended because the values are no longer current at the receiver; can only be configured as send address areas)

Peripheral areas (PI and PQ) and local data cannot be used for global data communication.

Data Transfer Process

Global data communication functions according to the broadcast method, meaning the receipt of the global data is not acknowledged. The sender does not receive information as to whether a receiver and which receiver has received the sent global data. If the process requires secure data exchange, use another service such as S7 functions.

Subnets for Global Data Communication

GD communication is possible:

- Via an MPI subnet only (between different stations) or
- Via the backplane bus only (for example, between S7 CPUs in a rack in multicomputing)

How Does an Address Area Become a Send/Receive Area?

The address areas that are involved in global data communication are configured in a global data table (GD table) using STEP 7:

- Every column is assigned to exactly one CPU which means the columns represent the CPUs involved in the data exchange (**maximum 15 CPUs**)
- Every row (or more exactly: every cell that can be edited in a row) represents the address areas via which one CPU only sends and one or more CPUs receive

When you have filled out the table, compiled it, and downloaded it to the CPUs involved, these CPUs send and receive cyclically via these address areas at the scan cycle checkpoint (meaning at the time at which the process image update takes place).

Special Feature: With the S7-400, configured global data can also be sent using SFC60 (GD_SND) for event-driven sending and received using SFC61 (GD_RCV).

10.2 Determining the Communication Capabilities from the GD Resources

10.2.1 Determining the Communication Capabilities from the GD Resources

You can determine how high the performance of an S7 CPU is with regard to GD communication using the following technical specifications ("GD resources"):

- The number of GD circles (in which the CPU can participate)
- The maximum number of net data per GD packet
- The maximum number of receive GD packets per GD circle
- The length of the consistent data per packet

The remaining documented GD resources are identical for all S7 CPUs and are not therefore relevant for selecting a CPU.

The technical data listed above provide indirect information about how much data the CPUs that are connected together via an MPI subnet or S7-400 backplane bus can exchange cyclically. How send data are "bundled up" to form GD packets and how many GD circles are used is illustrated in the following sections.

Tip

If you only want to transfer small amounts of data (only a few bytes) between a few CPUs, simply enter the address areas in the GD table and compile the table.

STEP 7 packs the data and allocates the resources automatically. You can see the total resources (GD circles and GD packets) used up after compilation in the first column ("GD Identifier") of the GD table.

The following sections outline the principle according to which GD packets and GD circles are used up.

10.2.2 Required Number of GD Packets

A GD packet is a data frame that is sent from one CPU only to one or more other CPUs "in one shot."

A GD packet contains the following maximum number of net data (see also the technical specifications of the CPUs):

- A maximum of 22 bytes in S7-300
- A maximum of 54 bytes in S7-400

Example 1:

You want to use the maximum send area for an S7-300 CPU to send from a data block. The bit memory area is to be used for the receiver CPU.

You enter the following in the GD table as the send area for an S7-300 CPU:

- DB8.DBB0:22 (that is an area of 22 data bytes in DB8 from data byte 0)

You enter the following in the GD table as the receive area for another CPU (must always be exactly the same size as the send area):

- MW100:11 (that is 11 memory words from MW100)

Rules

- If you want to send from more than one address area, you must take off two bytes from the maximum number of net data for each additional address area used.
- A bit address (for example, M 4.1) uses one byte of net data in the GD packet.

Example 2:

You want to send from a data block and from the process image of the outputs. The GD packet can then only be 20 bytes in size.

You enter the following in the GD table as the send areas for an S7-300 CPU:

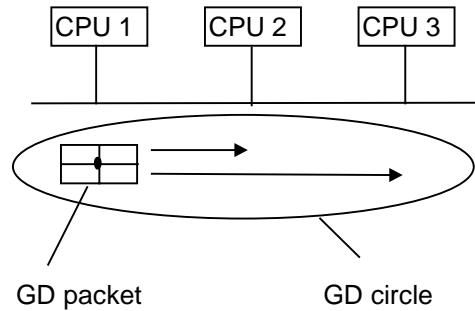
- DB8.DBB0:10 (that is an area of 10 data bytes in DB8 from data byte 0)
- QW0:10 (that is an area of 10 output words from QW0)

You enter the receive areas for the other CPUs similarly to the first example; the width of the receive area must be identical to the send area.

10.2.3 Required Number of GD Circles

What is a GD Circle?

All CPUs participating as sender or receiver in exchanging a common data packet form a GD circle.

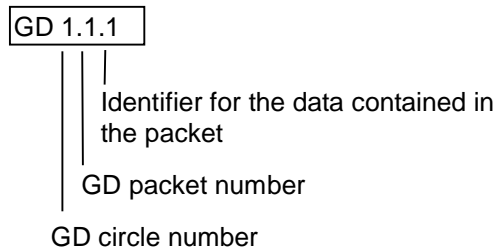


Example for Converting to a GD Table (After Compiling)

GD Identifier	CPU 1	CPU 2	CPU 3
GD 1.1.1	> MW0	IW0	IW0

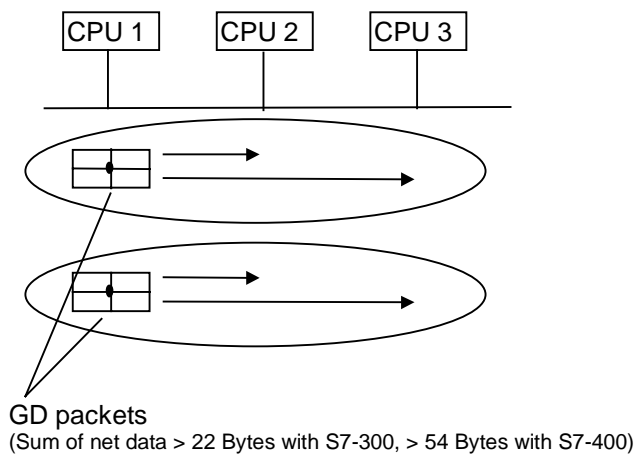
Legend for GD table:
">" indicates the sender

Structure of the GD Identifier:



When is Another GD Circle Required? (Case 1)

If more data are to be sent and received than can fit in one GD packet, an additional GD circle is required.

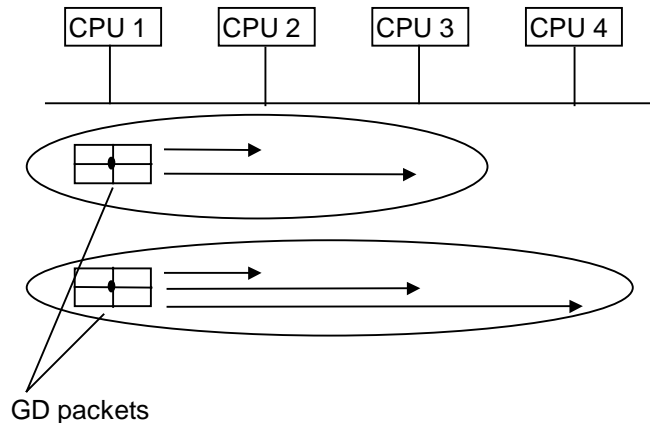


Example for Converting to a GD Table (After Compiling)

GD Identifier	CPU 300 (1)	CPU 300 (2)	CPU 300 (3)
GD 1.1.1	>MW0:10	IW0:10	IW0:10
GD 2.1.1	> MW100:4	IW30:4	IW20:4

When is Another GD Circle Required? (Case 2)

An additional GD circle is also required if the send and receive CPUs are not the same (then a new GD packet must be created).



Example for Converting to a GD Table (After Compiling)

GD Identifier	CPU 300 (1)	CPU 300 (2)	CPU 300 (3)	CPU 300 (4)
GD 1.1.1	> MW0	IW0	IW0	
GD 2.1.1	> MW100:4	IW30:4	IW20:4	IW30:4

Tip

It may be advisable to determine a CPU as the receiver for a GD packet although the packet is not required for these CPUs (as CPU 4 in the example above). If the sender and the receiver CPUs are the same, the number of GD circles can be reduced in this way, for example, for the sender CPU. In the example above, CPUs 1, 2, and 3 would then only form one GD circle because both GD packets would be grouped together to form one GD packet.

10.2.4 Exceptions for Calculating the GD Circles Required

Under certain conditions, the number of GD circles required can be reduced:

For S7-300:

If an S7-300 CPU ("sender CPU") sends one GD packet only to one other S7-300 CPU ("receiver CPU") only and this receiver CPU sends only one GD packet back to the sender CPU, only **one** GD circle is used.

This property reflects the technical data "max. number of receive GD packets per GD circle = 1."

In the example below you will see from the GD identifier (GD packet number) that only one GD circle is required.

Example (GD Table After Compiling)

GD Identifier	CPU 300 (1)	CPU 300 (2)
GD 1.1.1	> MW100	IW2
GD 1.2.1	IW4:3	>MW10:3

For S7-400:

If a maximum of three CPUs exchange GD packets and each of the three CPUs only sends one GD packet to the other two, only **one** GD circle is required here too.

This property reflects the technical data "max. number of receive GD packets per GD circle = 2."

In the example below you will see from the GD identifier (GD packet number) that only one GD circle is required.

Example (GD Table After Compiling)

GD Identifier	CPU 400 (1)	CPU 400 (2)	CPU 400 (3)
GD 1.1.1	> MW0	IW0	IW0
GD 1.2.1	IW2	IW2	> MW0
GD 1.3.1	IW0	> MW0	IW2

10.3 Conditions for Sending and Receiving

10.3.1 Conditions for Sending and Receiving

With the aid of a scan rate you can set the following for every CPU participating in the exchange of a GD packet:

- After how many cycles the GD packet is sent (only for the CPU designated as sender)
- After how many cycles the GD packet is received

Special Case: scan rate "0" means that the sending of the GD packet is event-driven (not cyclic) (only possible in S7-400 with SFC60/SFC61).

Example:

A scan rate of 20 entered for a GD packet at the sender CPU means that the CPU sends the GD packet at the scan cycle checkpoint after every 20 cycles.

A scan rate of 8 entered for a GD packet at the receiver CPU means that the CPU receives the GD packet at the scan cycle checkpoint after every 8 cycles (or more exactly, enters the received GD packet into the address area).

Sender Scan Rate

The following conditions should be maintained, however, to keep the communication load on the CPU at a low level:

S7-300 CPUs: scan rate \times scan cycle time \geq 60 milliseconds

S7-400 CPUs: scan rate \times scan cycle time \geq 10 milliseconds

Receiver Scan Rate

To prevent the loss of GD packets, they must be received more often than they are sent.

To guarantee this, the following must apply:

Scan rate (receiver) \times scan cycle time (receiver) \times scan rate (sender) \times scan cycle time (sender).

10.4 Response Time

10.4.1 Response Time

The response time for two stations that exchange GD packets via an MPI subnet can be calculated approximately using the following formula:

$$\text{response time} \approx \text{scan rate (sender)} \times \text{scan cycle time (sender)} + \text{scan rate (receiver)} \times \text{scan cycle time (receiver)} + \text{number (of MPI nodes)} \times 10 \text{ ms}$$

10.5 Global Data Transmission Using System Functions

10.5.1 Global Data Transmission Using System Functions

Event-driven data transmission is supported for S7-400 CPUs. A command from the system functions (SFC) in the user program determines when the data exchange occurs. SFC60 "GD_SND" (send global data) is available to send global data and SFC61 "GD_RCV" (receive global data) is available to receive global data. If the CPU supports event-driven data transmission, you must enter the scan rate "0" in the global data table. If a value greater than "0" is entered, global data transmission is cyclic and event-driven.

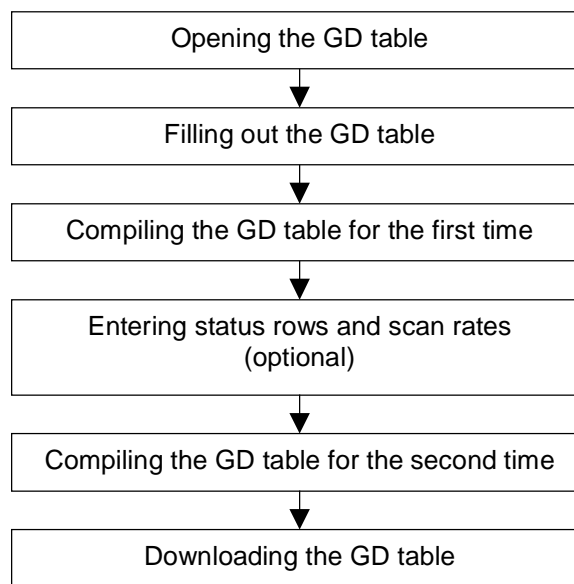
10.6 How to Configure, Save, and Download Global Data Communication

10.6.1 Procedure for Configuring Global Data Communication

Requirement

You must have configured an MPI subnet with all the required stations.

Overview Procedure



10.6.2 Opening the GD Table

There are two ways of opening a global data table:

- Open the entire GD table for a subnet
- Open the GD table for a CPU

Opening the GD Table for a Subnet (Recommended)

- In the SIMATIC Manager select an MPI subnet and select the menu command **Options > Define Global Data**.

Result: The GD table for the selected subnet is opened.

Opening the GD Table for a CPU

The following option for opening a global data table is recommended if you want to retrieve the GD table from the CPU during servicing and when searching for faults.

1. Select the menu command **GD Table > Open > Global Data for CPU**. The dialog box "Open" appears, in which you can select the project and station for the required CPU.
2. Select one of the following options:
 - "Online" to read the data directly from the CPU, or
 - "Offline" to obtain the system data for the CPU from the offline project
3. Select the project and double-click the station in which the required CPU is located to open it.
4. Select the "Blocks" object of the CPU whose GD table you wish to display.
5. Confirm your selection by clicking "OK."

Result: A global data table appears in which all CPUs participating in global data communication are entered in the column headers. However, the table only contains the values for the selected CPU.

To complete the empty cells of the GD table, you must update the table.

- Select the menu command **View > Update**. The GD table is now displayed with all entries.

10.6.3 Tips for Working with GD Tables

Inserting Global Data Rows

- Select the menu command **Insert > GD Row**

Deleting Global Data Rows

- Select a row and select the menu command **Edit > Delete**.

Inserting and Deleting CPU Columns

- Select the menu command **Insert > CPU Column**.

Deleting CPU Columns

- Select a column and select the menu command **Edit > Delete**.

Note on Deleting CPU Columns

If you delete a CPU column from a global data table, the corresponding system data of the CPU (offline) are deleted. Bear in mind that you must also delete the online data in the CPU for the deleted CPU column.

Requirement: The programming device must be connected to the CPU via the multipoint interface and the CPU must be in STOP mode.

Select the menu command **GD Table > Delete Global Data for CPU** and in the dialog box that follows, select the option "Online." Select the "Blocks" folder and confirm by clicking "OK."

Modifying the Column Width

The width of each CPU column can be modified. You can also make a column so narrow that it cannot be seen.

- Position the cursor on the right-hand side of the CPU cell in the table header, press and hold down the left mouse button, and drag the border horizontally to resize the column.

10.6.4 Filling Out the GD Table

Requirement

The scan rates and the GD status must be toggled off in the GD table.

Entering CPUs in the Table Header

1. In the global data table, click on a column in the table header. The column is then selected.
2. Select the menu command **Edit > Assign CPU**. The dialog box "Open" will then appear. Alternatively, you can open this box by double-clicking the column header.
3. Select the current project and double-click to open the station for the required CPU.
4. Select the CPU and confirm your selection by clicking "OK."
Result: The name of the selected CPU is displayed in the table header.

Entering Data in GD Rows

Requirement: You must have entered the relevant CPU in the table header (see above).

1. Position the cursor in a table cell and enter the required address. You can only enter absolute addresses (for example, IW0); symbolic entries are not possible.

Tip: A set of continuous addresses of the same data type requires only one entry in the global data table. In this case, enter a colon after the address and then the repetition factor. The repetition factor defines the size of the data area.

Example: IW4: 3 means: 3 words from IW4.

2. Switch from overwrite to insert mode by pressing the F2 key.
3. Edit the table as you would normally. You can also use the menu commands **Edit > Cut**, **Edit > Copy**, or **Edit > Paste**.
4. Finish your entries with RETURN.

Note

In a GD circle, use only either the communication bus (within an S7-400 station) or the MPI subnet (outside the stations). Mixed operation is not possible.

Defining Sender and Receiver Cells

Each global data row contains only one sender and one or more receivers. ">" indicates a sender. All cells in the global data table are preset as receivers.

- To define a data cell as a sender, highlight the cell and select the menu command **Edit > Sender**.
- To define a data cell as a receiver, highlight the cell and select the menu command **Edit > Receiver**.

Note

Cells that contain timers and counters can be used only as senders.

10.6.5 Saving and Compiling the GD Table for the First Time

Saving

When saving, you store the data which you have entered in your global data table in a source file.

- Select the menu command **GD Table > Save**
or
 1. Select the menu command **GD Table > Save As**
 2. Navigate to the project in which you want to save the global data table.
 3. Confirm with "OK."

Note

In order for the changes you made in the global data table to be saved in the system data as well, you must compile the global data table.

The data will automatically be saved in the system data of the relevant CPUs directly after compiling.

The data consistency between the source file and the system data can only be guaranteed if each change to the GD table is saved both in the source file (save) and in the system data (compile).

Compiling

A compiler run is necessary in order to compile the data you enter in the global data table into a language that the CPUs can understand.

The tabular data in the global data table are compiled into system data that the CPUs can process.

For each CPU column, the compiler creates the exact system data necessary for communicating with that particular CPU. For this reason, each CPU has its own GD configuration.

- Click the appropriate button in the toolbar or select the menu command **GD Table > Compile**. The global data table will be compiled to phase 1.
Result: STEP 7 checks:
 - The validity of the CPU specified in the CPU column headers
 - The syntax of the addresses you entered in the table cells.
 - The size of the data areas for the sender and receiver (the data areas for the sender and receiver must be of equal size)
 - That the global data in a row are exchanged either via the communication bus only or via the MPI subnet only. Mixed operation is not possible.

After the first compilation has been completed successfully, the GD table is in phase 1. In phase 1 you can edit the status rows and scan rates in the GD table.

10.6.6 Entering Scan Rates

Introduction

Global data exchange occurs as follows:

- The sender CPU sends the global data at the end of a cycle.
- The receiver CPU reads the data at the start of a cycle.

With the aid of the scan rate, you can determine after how many cycles the data will be sent or received.

Procedure

1. Compile the global data table if it is not already in phase 1 (you can view this information in the status bar at the bottom edge of the screen).
2. If no scan rates are displayed in the GD table, select the menu command **View > Scan Rates**.
3. Enter the required scan rates. You can enter data only in the columns in which the GD packet in question has entries.
Note: When you view status rows and/or scan rate rows, you can edit these rows only.
4. Compile the global data table again (phase 2).

10.6.7 Entering Status Rows

Introduction

For each global data (GD) packet you can specify a status double word for each participating CPU. Status double words have the ID "GDS" in the table. If you assign the status double word (GDS) to a CPU address of the same format, you can evaluate the status in the user program or in the status row.

Group Status

STEP 7 creates a group status (GST) for all global data packets.

The group status, which is also a double word with an identical structure to the status double word (GDS), is formed by linking all the status double words with an OR logic operation.

Procedure

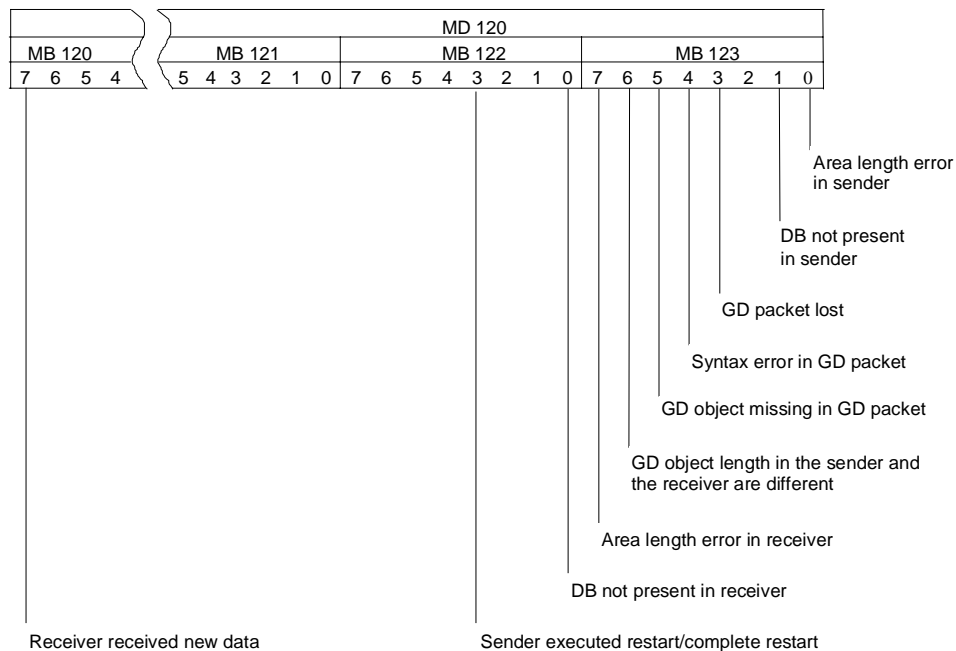
1. Compile the global data table if it is not already in phase 1 (you can view this information in the status bar at the bottom edge of the screen).
2. If no GD status rows are displayed in the GD table, select the menu command **View > GD Status**.
3. Enter the required status double words. You can enter data only in the columns in which the GD packet in question has entries. Enter addresses according to the syntax of the STEP 7 programming languages.
Note: When you view status rows and/or scan rate rows, you can edit these rows only.
4. Compile the global data table again (phase 2).

Structure of the Status Double Word

The following figure shows the structure of the status double word and an explanation of the bits set.

A bit remains set until it is reset by the user program or via a programming device operation.

Any bits not listed are reserved and have no significance at present. The global data status occupies a double word; to make it clearer, MD120 has been used in the figure.



10.6.8 Compiling the GD Table for a Second Time

After editing the status rows and/or scan rate rows, recompile the global data table to ensure that the new information is incorporated in the system data.

The system data generated in phase 1 are sufficient for running global data communication. You can download this data to the CPUs from the programming device. Phase 2 is necessary only if you want to change default values for the scan rates or make entries in the status rows.

10.6.9 Downloading the Global Data Configuration

During the compiler run, the data in the global data table are converted into system data. If no errors are displayed during compiling, you can transfer the system data to the CPUs:

- Select the menu command **PLC > Download**.

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